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New Frontiers for Paper Products

By R. G. Macdonald[1]

Much has been written about the contribution that industries have made to the war effort. For instance, few companies that have had anything to do about creating the atomic bomb have failed to advertise the fact. This has been done with justifiable pride. Soon it will be time for all to take account of stock and to determine and analyze what the stress of war may have done for industry which was probably accomplished at tremendous cost to the general welfare of the country.

Old industries can probably take a measurable amount of pride in having carried on as well as they have in the face of overwhelming difficulties relative to manpower, raw materials, equipment, and many other things. The need for doing the impossible in many cases resulted in great gains in knowledge and techniques but much of this experience would have been of even greater value to the industry and the country if it could have been acquired by young engineers and operating men new to the industry.

With the war a thing of the past, the next job is to advance an economy that will be worthy of the great sacrifices that have been made. Political stress is being placed on the necessity of having jobs for all who want them. In providing for them consideration needs to be given to the means by which employment is sustained.

"Markets," says George A. Sloane, President of the Nutrition Foundation," are not developed or production justified by promises that are in conflict with the fundamental law of supply and demand. Consumer demand must occur before useful and profitable employment can ensue and violent and destructive fluctuations in employment can only be dealt with by cooperative effort in industry to foresee and forstall these fluctuations."

The public is looking with increasing hopefulness to scientific research as one of the principal means by which the solution of the postwar economic problems may be attained. To keep the faith more industrial concerns and groups must undoubtedly take the initiative in developing a long time point of view in scientific research. By gaining more fundamental and technical knowledge, industry can strengthen the system of enterprise to the satisfaction of individual wants.

During the war the wants of industry's biggest customer became clearly defined. It was therefore merely a matter of cooperative effort and the application of fundamental principles that brought about successful production—in time. Note that the fruition of the atomic bomb was the result of a race against time. The fundamental knowledge was there as was the money and the scientific and industrial resources of the nation.

VANCE P. EDWARDES
President, Technical Association of the Pulp and Paper Industry.

In a lesser way the pulp and paper industry made its contributions: its V-boxes, its waterproof war maps, its nitration of wood pulp, its packages made to protect contents from water vapor, sea water, rodents, insects, etc. In all cases cooperative effort focused on the solution of all the immediate problems resulted in success. For a while paper in its various forms just had to be made to do the required job because it was the only thing available. Later, it became relatively scarce and other materials becoming more plentiful entered the materials picture, primarily because cost was no objective and the job needed to be done.

With the return of competitive merchandising, scientific investigation will need to take the place of hunch in deciding the policies and mapping plans. In the paper

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industry contributions to the art of packaging were of great importance and still offer one of the most likely looking fields for continued advancement.

Other industries that have made contributions to packaging feel the same way about it. All industries serving this field competitively will have to make an immediate, concerted effort to study the properties and protective values of their own and their competitors packaging materials and to determine consumer acceptance and point of view. The two objectives will call for different personnel and equipment and the creation of a new breed of industrial investigators—the market research men.

Packaging progress, which is a big objective and will be the subject to which this discussion will be limited, will in this critical postwar period depend more than ever upon research. The packager will have many new materials at his command. Investigation of the characteristics of these materials and adaptation of them to packaging problems represents a great task as it will be necessary to understand not only the properties of each individual type of paper, plastic film, or metallic foil used, but also the combined characteristics of the countless possible laminations of them and of the adhesives used to unite them.

In recent years the ability of packaging material and packages to keep the contents at a uniform desired moisture content has been of prime concern to manufacturers. In this connection some packaging materials such as paper are susceptible to moisture penetration. Many of the synthetic films are not porous in the ordinary sense but because they dissolve moisture, carbon dioxide, and other gases and vapors, they can still be penetrated by diffusion through the film.

Work such as that the Technical Association of the Pulp and Paper Industry is doing on the standardization of tests and the accumulation of data on the properties of packaging material will be of great importance in the postwar era. Such tests include water vapor permeability; permeability to fixed gases, air, carbon dioxide, oxygen, and nitrogen; permeability to organic vapors; and the penetration of water, oil, and grease. Also important are the problems of aging and the specific effects of temperature, oxidation, and light. The mechanical tests of compression, tumbling, and impact will need fuller study.

GUNNAR W. E. NICHOLSON
Vice President

R. G. MACDONALD
Secretary-Treasurer

Along with the scientific research should go consumer or market research. A capable organization for this, be it one or more individuals, will collect, analyze, and digest outside research studies; abstract pertinent data; represent the consumers point of view in any management meeting; conduct small scale field surveys wherein consumer interviews would help to protect against bad marketing practice or packaging errors; plan, project, and direct full scale professional surveys; and analyze and interpret the results.

Packaging Frozen Foods and Drugs

In considering a single general market for packaging papers, the frozen foods industry offers a good example. Although various foods, especially fish, have long been frozen, commercial packaging began in the Pacific Northwest in 1908 when berries were first preserved by cold packing. The first frozen food packages were introduced in 1930 when the General Foods Corporation put out a half million pound pack of fruits and vegetables on a patented quick freezing apparatus developed by Birdseye.

Today, the industry is composed of from 450 to 500 frozen food processors of fruits, vegetables, seafoods, meats, and poultry. Up until recently most of the frozen food production went into the institutional and industrial markets, but during the last year or two, the serving has been strongly toward the retail package, and now more than 50% of many vegetables are packaged in retail size and from 25 to 30% of some fruits. In 1945 there will probably be from 700 to 800 million pounds of frozen fruit and vegetable production.

The quick-frozen foods industry is at present making new strides forward and offers a rapidly growing market for packaging materials. With each month comes a report of a new product entering this field. Starting almost from scratch a few years ago, the quick frozen eviscerated poultry pack amounted to 90 million pounds in 1944. The same may be said for quick frozen seafoods. Meats are expected to be a big civilian item after the war. At present the entire pack is going to the armed forces.

There are now between 35,000 and 40,000 retail stores selling frozen foods. The commercial frozen

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A. E. BACHMANN *(left)*

JOHN A. HANSON *(right)*

foods business sales volume is about 200 million dollars. This is small when compared to the 17 billion dollars a year in the sale of perishable foods in this country. Progress has been held back by the lack of refrigeration facilities. The constantly growing frozen food industry will affect many related industries such as refrigeration, packaging, insulation, etc. The smallest home freezer, which, by the way, will require the use of wrapping materials will add 300 kw. hr. per year to a utilities power line. Frozen cooked foods is one of the latest developments and twenty large packers are already putting up frozen cooked foods items.

In the drug and pharmaceutical field, although there has been a trend away from the paperboard container, with or without metal ends, they are not expected to be eliminated. Lightweight moistureproof canisters made from paperboard with some of the new protective coatings, can easily find a place in the drug industry if protection and cost factors are comparable to metal. Unit packages, laminations and combinations of paper and other flexible films, widely used in the drug industry for tablets, pills, capsules, and powders, will find expanding uses because of their protection against moisture. Folding cartons, eliminated in the interest of conservation, will return, but many products which were cellophane or glassine wrapped will be cartoned in order that they may be packaged on high speed production lines.

Peacetime Requirements of Packages

The packaging of goods in the peacetime market will be highly competitive and for this reason the cost of packaging will have a considerable bearing on the selection of packaging materials. Only in rare instances will packaging be required to withstand the rigorous conditions demanded of it during wartime. Rather, there will be considerably more emphasis placed on the appearance of the package, how it will merchandise, and what convenience it will offer. Since most of the market for packaging paper is in industry, the paper manufacturer would be well advised to increase his knowledge of the packaging problems of these industries. The reason for their respective choices of certain packaging materials is not always obvious. Paper has certain characteristics which are desirable for some purposes. The flexibility of paper offers many possibilities for use which other materials do not allow. Cost will always be an important factor in its favor. It is assured that there will be continued improvement in the quality of paper and paperboard products. They will be offered with better

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A. E. MONTGOMERY *(left)*

W. E. BRAWN *(right)*

finishes, higher strength, and better colors. Improvement in quality will increase the use of a material which finds application to the packaging field.

In making paper a better packaging material through the use of coatings, impregnants, laminations, etc., the cost will need to be watched. During the war the development of the V-box was a great accomplishment as a shipping container. It will, in the postwar period, be recognized as a most desirable package because of its high protective qualities, its comparative light weight, and lower cubic displacement. It is, however, relatively expensive and possibly too well made for any civilian need. Possibly the lessons learned in its development will provide a product that will meet the cost requirement.

The aforegoing comments have been limited to a specific field of paper development. In this field the paper industry finds itself a competitor with other industries. When a company competes with another for a market limited to paper as a commodity it becomes necessary to utilize its private technical and sales facilities to obtain its share of the market. Industrial packaging is unique in that the first problem of the packager is to decide on the type of packaging material that he will use. It is of secondary interest which company will be asked to supply it. In fact, to protect his source of supply he will probably buy from more than one company.

The Paper Industry as a Competitor

The paper industry therefore has an industry job to do to meet the competition of other materials. It will be a job for well qualified technical and market research men to know the packager's problem from all angles and endeavor, if possible, to have this problem more than adequately met by a superior paper product.

This will require an invasion of paper industry representatives into the field of the packager. Not only will he need to make specific contacts with purchasers but he will need to keep up to date on the purchaser's industrial research. This can be done to some extent by attending meetings of the various industrial technical associations where valuable contacts will be made with the men who are leading the parade of technical advancement.

These societies, including TAPPI, have a fundamental similarity but also a distinct individuality. They have all had a large part in the development of their respective industries. They all hold meetings for the presentation and discussion of original papers. They publish papers and reports disseminating

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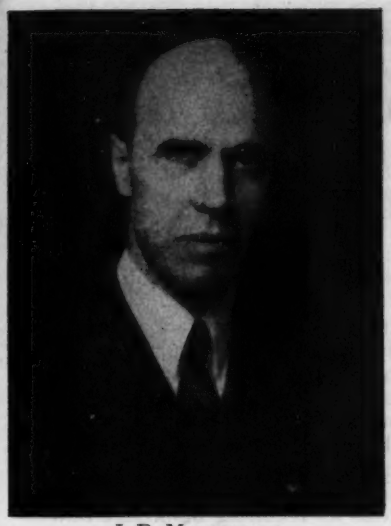

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knowledge of value to engineers, chemists, and operating executives. They develop and promulgate standards, codes, and recommended practices. They encourage technical research, tests, and other original work and encourage the mutual exchange of knowledge and experience among their members.

It is well for companies to encourage its men to participate in the activities not only of the technical association serving the company's industry but also of its customer industries. The paper industry has been lax in the latter and will need to give this matter more attention in the future. This relationship will bring to a company up-to-date information on the progress of events in its field of activity or prospective activity and also provides an opportunity to participate in its standardization work which produces much better results by the cooperative effort than can be had in the company acting independent of such organizations. Also, opportunity is provided for cooperative research bringing results which a single company probably could not afford to develop in its own organization.

W. F. GILLESPIE

Member of TAPPI Executive Committee

Package Machinery Has Work Ahead

SPRINGFIELD, Mass., September 22—Accumulation of civilian orders for various types of wrapping machines plus a large amount of replacement and repair parts assures the Package Machinery Corporation that its entire plant will be kept going at peak production for at least the next two years, according to Tom Miller, vicepresident in charge of sales. This makes no allowance for new orders, company officials fully expect will be forthcoming, as well as renewal of machine orders that had to be shelved prior to or after Pearl Harbor.

The company is now operating with a force of 450 men, the result of gradual weeding out that has taken place since its war peak employment of 691 production workers. Most of the reduction can be accounted for by the 175 men whose names adorn the company's service honor roll.

George C. Ferver, vice-president and assistant to the president, said the job of every man who went into service is waiting for him, though he said only about 50 per cent are expected to reapply. However, the company wants right now 100 skilled machinists principally to build up its night shift.

Plans now call for double its prewar number of production workers to carry on under the present 40-hour week. Before the end of the year it is also expected to resume the company's apprentice training program, which was temporarily dropped when it went 100 per cent into war production.

High priority orders dating back before the end of the war will keep the company going at top speed throughout the balance of 1945 and it is intended to work in, as much as possible, some new civilian orders on its books.

Kimberly-Clark Closes in Washington

NEENAH, Wis., September 17, 1945—The Kimberly-Clark Corporation will close its Washington, D. C. office on September 30, it was announced today by C. F. Jenkins, General Sales Manager. L. E. Pasek, who has been in charge, is returning to Neenah, Wisconsin to assume new duties as Kimsul Product Engineer.

The Chemical Warfare Service Development Laboratory

Massachusetts Institute of Technology
Cambridge, Massachusetts

The Chemical Warfare Service Development Laboratory at the Massachusetts Institute of Technology under the command of Lt. Col. Willard J. Slagle celebrated its fourth birthday on June 1st of this year. This is an army laboratory staffed by Chemical Warfare Service officers and by civilians. Its purpose, as stated during the original planning, "is to be a development laboratory and not a research laboratory—to act as liaison between the army and industry, i.e., to enable the armed forces to take advantage of chemical research".

That this installation should have been planned and activated so early was because of the foresight of the Chemical Warfare Service and particularly to that of Col. Bradley Dewey, president-elect of the American Chemical Society. These men realized that the research facilities of the main Chemical Warfare Service laboratories at Edgewood Arsenal would be taxed to capacity in time of war, also that it would be dangerous to concentrate all chemical warfare research at one installation during such a period.

During the autumn of 1940 unofficial discussion began between Col. Dewey, representatives of the Chemical Warfare Service, the N.D.R.C., and M.I.T. about the establishment of a C.W.S. laboratory at the Massachusetts Institute of Technology. It was pointed out that such a laboratory at Cambridge could take advantage of the large staffs of scientific personnel available at M.I.T., Harvard, and the other educational institutions in the Boston area as well as the staffs of technical men in the varied manufacturing plants in the vicinity.

The Massachusetts Institute of Technology agreed to provide the floor space required by leasing its proposed new chemical engineering building to the Chemical Warfare Service for its exclusive use for the duration of the national emergency.

The new laboratory was officially activated on June 1, 1941 under the command of Lt. Col. Jacquard Rothschild, then Capt. Rothschild, and housed temporarily in the main buildings of the Institute. On November 3, 1941—one month before Pearl Harbor—the permanent quarters were in operation. At that time, the new building, three stories high and as large as a football gridiron, seemed capable of meeting any future needs of the Chemical Warfare Service. But in a few short months every foot of floor space became invaluable. The task of supplying an army with weapons and defensive equipment better than the well-prepared enemy we faced, presented innumerable technical problems all requiring immediate solution. To handle the flood of projects assigned to the laboratory men from practically all the engineering professions were called in, and with them chemists, physicists, mycologists, anthropologists, and representatives of all the other scientific "—ists". Some were assigned from the Officers' Reserve, others were hired as civilians.

Along with the men a great many women were employed. Those who had already specialized in some branch of the sciences were easily placed in jobs for which they were suited. Others were trained as draftsmen, laboratory assistants, or operators of special equipment or instruments.

The enthusiasm and faithful attention to the job shown by these women proved to be a major factor in the successful operation of the laboratory.

In order to handle the wide variety of projects assigned, the staff is divided into divisions each with its chief. The divisions are composed of sections which in turn have their group leaders. The divisions serve one of three functions in the laboratory; executive control, service, or research. The executive group has charge of the laboratory as a whole and performs the necessary purchasing and administrative duties. The service divisions include an editorial group charged with the publication of the laboratory reports, a library, stock room and tool crib, photographic and

The Chemical Warfare Service Development Laboratory

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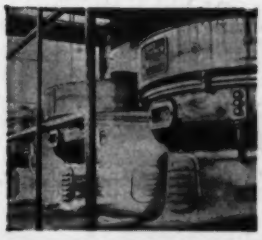

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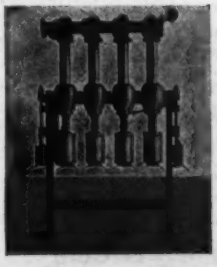

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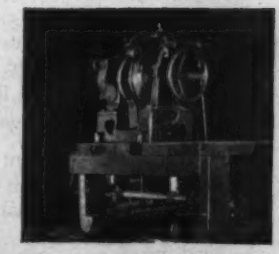

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Paper Making and Research Corner the Chemical Warfare Service Laboratory

printing shop, glassblower shop, an engineering division part of which are the machine and carpenter shop, and the drafting rooms, and an analytical division. The engineering and analytical divisions handle occasional research problems for which they are equipped but their main function is to service other divisions. The research divisions are divided according to the type of work they carry out, such as the chemical engineering division, the chemical development division, etc.

Accomplishments

A description of the work done and accomplishments of the laboratory is not possible at this time because of the security regulations. The scale on which the work has been carried out varies over a wide range. Everything from analytical tests with the electron microscope to pilot and semiworks plants producing tons a day, has been handled. In one case the entire production of one of the chemicals used by the American and allied armies has been made at this laboratory.

Considerable work has been done here with pulp and paper products. Handsheets can be made from a 10-pound beater, a sheetmold, and cylinder drier. The laboratory is equipped also with all the usual paper testing instruments installed in a temperature and humidity controlled room.

One of the problems peculiar to the Chemical Warfare Service is the protection of food, personnel, and materiel from the effects of toxic gases. Along this line coated and impregnated gas-resistant papers have been developed which are suitable for the fabrication of protective capes, food packages, and coverings for army equipment and supplies. Another development was the production of gasproof paper bags for the transportation of vesicant contaminated materials.

Methods of coating and impregnating paper were developed for sheets that would give color signals when in contact with the ordinary toxic gases used in chemical warfare. These are active with vapor as well as liquid contamination.

A great deal of work was done on the construction of filter papers. Various fiber compositions and paper treatments were investigated both on a laboratory and plant-run scale.

One of the ever-present problems in this war has been the mildewproofing of army supplies and equipment. The proofing of papers was carried out as part of the general program on mildewproofing.

It is unfortunate that no definite formulas or processing methods may be described at this time. It may be that after the war is finished this information will be released for civilian use.

From the quantities of material captured by our troops it is known that the Germans were well prepared to use poison gas. That it was not used is proof in itself that they were aware of the developments in chemical warfare by laboratories such as this. It was an insurance policy, the premiums of which were small, that paid off by saving the lives of thousands of our soldiers.

Mosinee Starts Improvement Program

The Mosinee Paper Mills Company, Mosinee, Wis., has launched a $200,000 improvement program, engineering plans for which were made by C. M. Green, plant manager, and S. R. MacSwain, chief engineer. The program is expected to extend over several years and will increase efficiency and quality of products, according to N. S. Stone, Mosinee, vice president and general manager.

New evaporators of the most modern type will be installed in the soda recovery department and will be in operation early in 1946, under present plans. A complete new pulp-washing system will replace the present equipment. Better pulp-mixing facilities will be incorporated and better conditioning of the pulp in the processing stage will be provided. Storage capacity in this department will be increased. The new machinery will be installed next spring.

Westminster Adds to Board

NEW WESTMINSTER, B. C., September 1, 1945—A. Donald Lauder, partner in the investment firm of Lauder Mercer & Co., Vancouver and R. L. Cliff have been added to the Board of Directors of the Westminster Paper Company.

Mr. Cliff has interests in the B. C. Manufacturing Co., Westminster Shook Mills Ltd., both of New Westminster; and Western Containers of Seattle, Oakland and Los Angeles. Elmer M. Herb was recently elected president of the Westminster Paper Co. following the election of his father, J. J. Herb, to be chairman of the board.

John S. Sensenbrenner Named

Lieut. Col. John S. Sensenbrenner of Neenah, Wis., has been named a member of the War Department Price Adjustment Board. The board has authority to renegotiate war contracts.

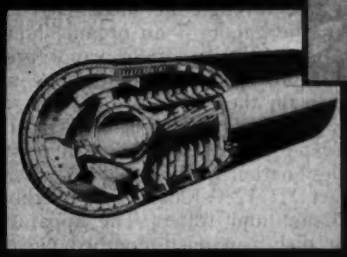
Colonel Sensenbrenner, veteran of the first World War, has served three years in World War II. Before volunteering in World War II he was vice president of the Kimberly-Clark Corporation of Neenah and a director of numerous industrial companies.

Worthington Staff Seeks 20 Per Cent

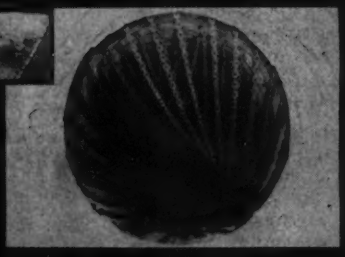
HOLYOKE, Mass., September 22—The employees of the Worthington Pump and Machinery Corporation, through their union, have asked for a flat 20 cents an hour pay increase. This request was denied by the management and the union is now planning its future strategy. No strike is in the immediate offing, Leon Massa, president of the CIO local said. He refused to say what course the union might take.

UNAX ROTARY KILNS

HEAT EXCHANGERS



CHAIN SYSTEMS



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Instrumentation Studies. LI*

Penetration of Papers by Water Vapor. V.

Methods for Measuring Vapor and Gas Permeability—a Bibliographical Study

By the Staff of The Institute of Paper Chemistry

A portion of the material included in this Instrumentation Study was submitted to the American Paper and Pulp Association as Report No. 30, Part IV, on February 1, 1944. For publication in the *PAPER TRADE JOURNAL*, the material has been brought up to April 1, 1945.

Abrams, Allen. Protective wrappings. *Modern Packaging* 5, No. 5:51-53; No. 6:88-91 (Jan., Feb., 1932)—A general article which includes a description of the vapometer (see Abrams and Chilson).

Abrams, Allen, and Brabender, George J. Factors affecting the determination of water vapor permeability. *Paper Trade J.* 102, No. 15:32-41 (April 9, 1936); *Tech Assoc. Papers* 19:121-130 (June, 1936); *C. A.* 30:5035; *B. C. A.* 1936B:587; *B. I. P. C.* 6:379; *T. S.* 103:262.—The permeability of sheet materials to water vapor is influenced by the vapor pressure differential on the two sides of the test sheet but, in the absence of definite measurements, it is unsafe to make assumptions as to what this differential may be. Water vapor permeability is inversely proportional to the distance between the test sheet and the water surface in the testing equipment. An initial seasoning period is necessary before a constant rate of water-vapor transmission is established; this is a matter of minutes with light, permeable papers, and may be a matter of days with heavy, moistureproof sheets. At present, it appears simplest to use an empirical method and equipment which will give results predicting what a sheet will do under service conditions; among the points to be observed are standardization of dimensions, lightness, prevention of edge leakage, ratio of test-sheet area to water area, and the distance between the water surface and the test supply. A new vapometer is described.

Abrams, Allen, and Chilson, Warren A. Vapor transmission through papers. *Paper Trade J.* 91, No. 18:175-180 (Oct. 30, 1930); *Tech Assoc. Papers* 14:379-384 (May, 1931); *Paper Ind.* 12, No. 6:1047 (Sept., 1930); *Paper Mill* 53, No. 38:24-28 (Sept. 20, 1930); *C. A.* 24:6011; *T. S.* 92:159.—Results are given of an investigation of a simple and reliable method for the determination of the resistance of paper to the penetration of water vapor. This consists essentially in exposing the paper to water vapor for a definite time, having saturated air on one side of the sheet and a definite lower humidity on the other side. As a result of the work, the following technique is tentatively suggested for adoption as official; Place 50 ml. of distilled water in an aluminum can having an area of 7.07 inches over the top, firmly attach a sheet of the paper to be tested over the top, weigh to 0.1 mg., place in a room at constant humidity and tempreature (preferably 70° F. and 50%; 65%. humidity can be used, but the vapor transmission rate is considerably reduced) in front of an electric fan and at such a distance as to give an air velocity of about 600 to 700 feet per minute over the paper, after a suitable period (6 to 24 hours) weigh again, and from the loss calculate the transmission of vapor through the paper per 100 inches per hour. The following conclusions are drawn: (1) The rate of water-vapor passage through papers is largely dependent upon the vapor pressure "potential" (i.e., the difference in vapor pressure) on the two sides of the paper. (2) Testing the vapor-transmission rate under vacuum appears to offer some simplification of equipment; at the same time, the shorter test periods involve a lower degree of accuracy in results, particularly with sheets of high moistureproofness. (3) The tentative standard method suggested gives results which are directly comparable with the results of moisture losses in actual packaging experiments using the same papers. (4) The ratio between water-vapor loss from an open can and from a can covered with paper is not constant under varying test conditions; therefore, this simple method cannot be adopted for standard usage. (5) Water-vapor transmission rates bear a direct relation to liquid water penetration tests on homogeneous papers, but this relation does not hold for heterogeneous papers. (6) Porosity, or air penetration through a sheet, bears no direct relation to the water-vapor transmission rate through the sheet. (7) The transmission rate of the vapor of an organic liquid at any temperature is a function of the vapor pressure of that liquid, provided the liquid does not exert a solvent action on the sheet.

American Society for Testing Materials. Tentative method of test for water vapor permeability of plastic sheets. A.S.T.M. Designation D 697—42T. A.S.T.M. Standards 1942, part III:1280-1283.—Two methods are proposed: desiccant and water. The apparatus consists of the test dish (an open-mouthed cup or dish with an area of at least 30 cm.), a template (circular metal disk ⅛ inch in thickness and having the edge beveled to an angle of 45°), a desiccant (anhydrous magnesium perchlorate or other), petrolatum (to be applied to the beveled edge of the template), a balance, tare weight, and test chamber. The test is made at 77±2° F. and 50±2% relative humidity. A current of air of at least 500 feet per minute is passed over the exposed faces of the specimens under test. Details are given of the two procedures.

Aono, Takeo. Permeability of gases and vapors through packing papers and a simple measuring apparatus. *J. Soc. Chem. Ind. Japan* 35:443-444B (Oct., 1932); *B. C. A.* 1933B:57; *T. S.* 97:131; *C. A.* 27:1165.—An apparatus is described for measuring the gas permeability of paper by allowing a definite volume of the gas under a given pressure to expand through the test specimen to a definite volume at a lower pressure. Equations for calculating the permeability coefficient and a table of values for various packing papers are given.

*This report is one of a series issued as a part of the Instrumentation Program of the American Paper and Pulp Association.

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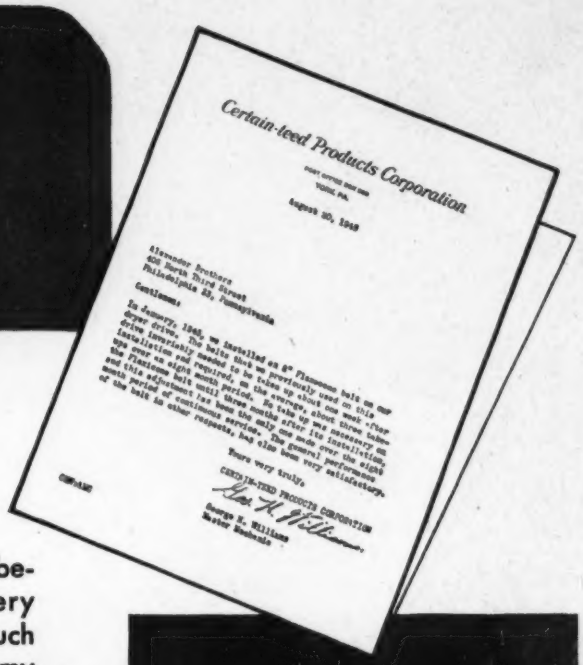
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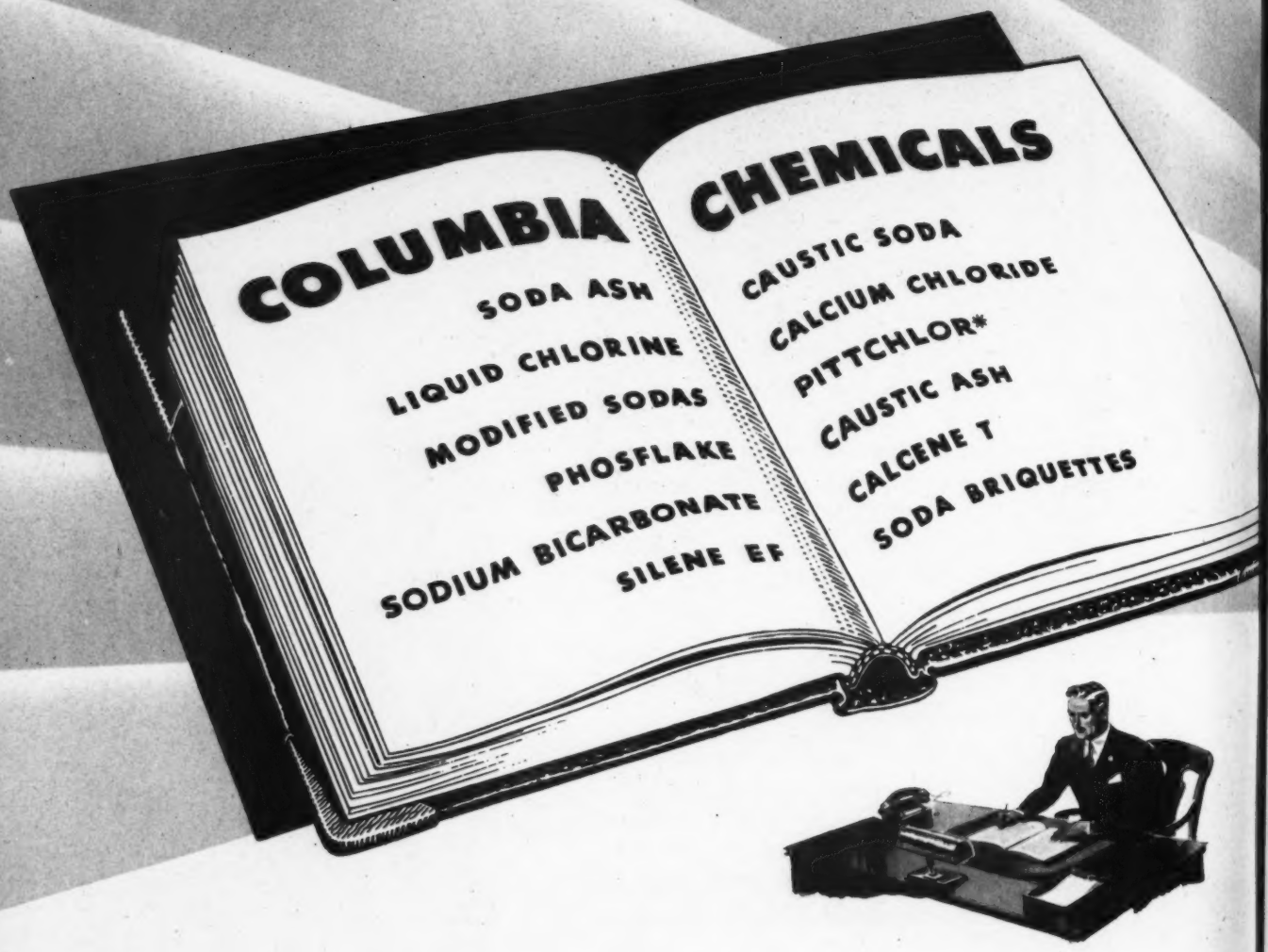

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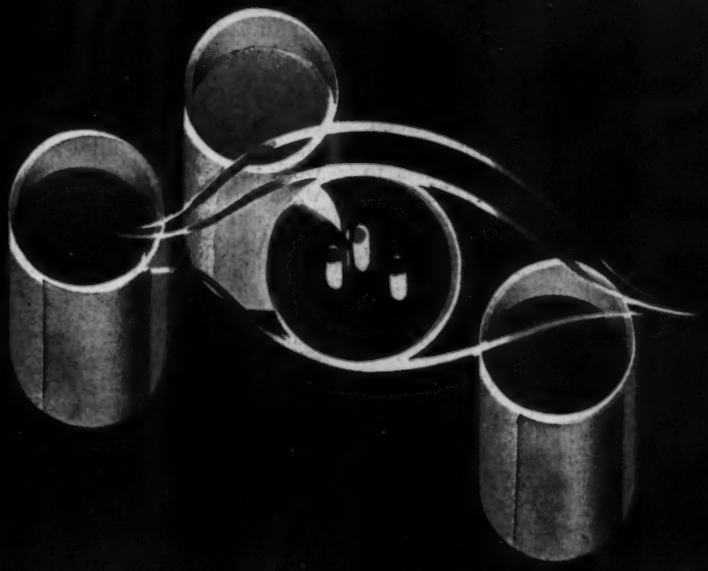

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Babbitt, J. D. The diffusion of water vapors through various building materials. *Can. J. Research* 17, Section A, No. 2:15-32 (Feb., 1939).—The diffusion coefficient was measured by an application of the cell method, using calcium chloride as the desiccant. Two arrangements are described, one for thick samples and one for samples up to 1 inch in thickness. Most of the measurements were made at a temperature of 90° F. and at 75% relative humidity. The increase in weight was plotted against the time; when a straight line was obtained, the slope was measured; this gave the vapor transmission per hour. Results are given for various fiberboards, wood, kraft paper, and various other building materials.

Badum, E. Permeability of organic materials to water. *Kautschuk* 14:231-232 (1938); *C. A.* 33:9486.—A method is described for the measurement of permeability at 25° C. by enclosing an aluminum dish, containing felt saturated with water and closed with a sheet cover of the material under investigation, over calcium chloride in a desiccator. From the loss in weight of the dish and the dimensions of the cover, the permeability is calculated.

Barnhart, P. S. [Tests made by the Glassine Association—creasing test]. *Tech. Assoc. Papers* 27: 136-137 (June, 1944).—Data are given for the water vapor permeability of 20-pound glassine laminated with 5, 8, and 18 pounds of laminant in the flat state, with the Institute of Paper Chemistry crease, with a crease made on the bag machine, and made into bag form. The General Foods method was used at 100° F. and 95% relative humidity. In one case, with the I.P.C. crease (using 14 creases, 7 in each division), the increase was 94%; with creases like those in a bell-loading bag, the increase was 72%; however, with a bag made on a bag machine, the increase was 97%.

Barrer, R. M. Permeation, diffusion, and solution of gases in organic polymers. *Trans. Faraday Soc.* 35:628-643 (1939).—The diffusion cell is based on that described by Schumacher and Ferguson. Data are given for helium, hydrogen, nitrogen, and argon through rubber, neoprene, and various synthetic resins.

Birdseye, Clarence. Some scientific aspects of packaging and quick-freezing perishable flesh products. II. Packaging flesh products for quick-freezing. *Ind. Eng. Chem.* 21, No. 6:573-576 (June, 1929).—The relative moisture-vaporproofness was determined as follows: The paper is sealed tightly over the top of a glass crystallizing dish. One edge is then broken just enough to allow the insertion of a pipet. About 10 to 15 ml. of water are placed in the dish, after which the broken edge is tightly sealed again. These dishes are placed in the constant temperature oven, which is regulated to within 0.5° C. and in which calcium chloride or sulphuric acid is distributed so that the atmosphere in which the dishes are exposed represents a practically zero relative humidity. The air in the oven is constantly agitated by a small fan connected to a small motor. The dishes are weighed at the beginning of the test and after 24 hours in the oven and the loss in weight is calculated to grams of water vapor lost per square meter of surface exposed per 24 hours at 38.33° C. The relative moisture-vaporproofness of fifteen samples of cellophanes, parchment, glassines, and waxed papers is reported.

Boor, L., and Dixon, J. K. Application of a thermal conductivity method to the determination of moisture vapor transmission of packaging materials. *Tech. Assoc. Papers* 27:689-697 (June, 1944); *Paper Trade J.* 117, No. 14:64,66 (Sept. 30, 1943); 119, No. 18:26-34 (Nov. 2, 1944); *Paper-Maker* 109, No. 1:TS1-8 (Jan., 1945); *B. I. P. C.* 15:136.—The thermal conductivity of air-water vapor mixtures has been used to measure moisture vapor transmission; this may be measured by determining the temperature of an electrically heated wire surrounded by the gas in a container whose walls are at a fixed temperature; this is accomplished by measuring the electrical resistance. The permeater (developed by Shakespeare to measure the permeability of balloon fabrics to hydrogen) consists of two flanged members, hinged together, between which the test substance is clamped with a suitable seal. In the present work the space in the bottom member was filled with water to within about ⅛ inch of the top. The test sheet was clamped between the two flanges and rested on supporting rings cut in the bottom half of the clamping unit. The thermal conductivity cell was mounted on a cell block provided with inlet and outlet gas passages. A circular disk, 6 inches in diameter, serves as a test sample, which is first waxed with a mixture of beeswax and petrolatum over 0.5 inch of the edge; the test area is 5 inches in diameter. The measuring unit consists of two heated platinum coils, operating at about 120° C., one of which is sealed in a dry atmosphere and the other is exposed to the air to be measured. Various details, such as the compressed air source, the flowmeter, humidity control, calibration, response, and reproducibility of readings, are discussed. In carrying out a test, dry air was passed through the cell block until a stable reading was obtained; the sample was sealed between the flanges and the dry air stream was directed into the upper head space and out through the cell block at a rate of 500 cc. per minute for 15 minutes; the flow was then reduced to 100 cc. per minute and continued until the galvanometer reading became steady. Data are given for this method, the Payne cup method, and a modified GFMVT method. From the data obtained, it appears that the Permeameter can be used to measure the permeability of substances in the range of 0.1 to 10 grams per day per 100 sq. in. By using air flows up to 500 cc. per minute, permeabilities up to 60 to 80 grams per day per 100 sq. in. may be measured. The four principal factors influencing the rate of permeation are: the rate of removal of moisture from the top surface of the sheet; the rate of moisture pickup by the bottom surface, the rate of diffusion through the sheet, and the changes in rate of permeation caused by swelling of fibers and coatings. Suggestions are made which might lead to an accelerated testing method.

Brabender, George J. Determining water vapor permeability of sheet materials. Progress report. *Paper Trade J.* 108, No. 4:39-43 (Jan. 26, 1939); *Tech. Assoc Papers* 22:251-255; discussion, 96-99 (June, 1939); *C. A.* 33:4027; *B. I. P. C.* 9:255.—The temperature and humidity conditions prevailing within the testing chamber must be controlled within very narrow limits to obtain reasonable check results. When very permeable sheet materials are being tested, in order to avoid saturation of the desiccant, the amount of the latter within the test cell must be considerably greater than that previously proposed; bringing fresh desiccant in contact with the low-humidity face of the sheet at intervals during the test will also eliminate the factor of saturation. Large percentage, but low absolute, deviations may be expected in values of water vapor permeability for materials of low permeability, because of ordinary vari-

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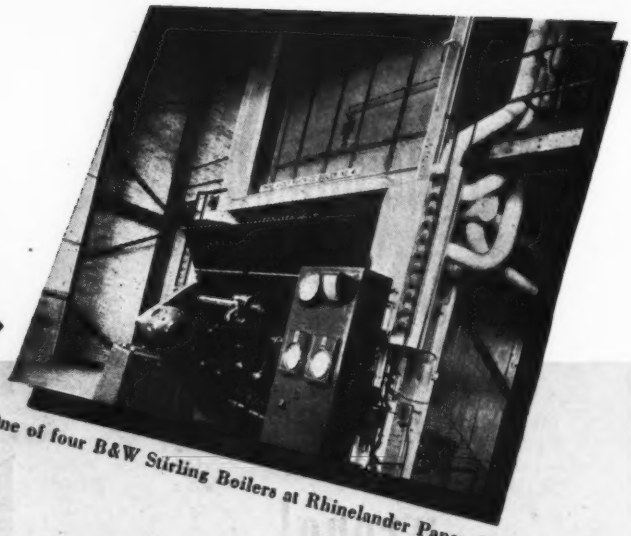

One of four B&W Stirling Boilers at Rhinelander Paper Co.

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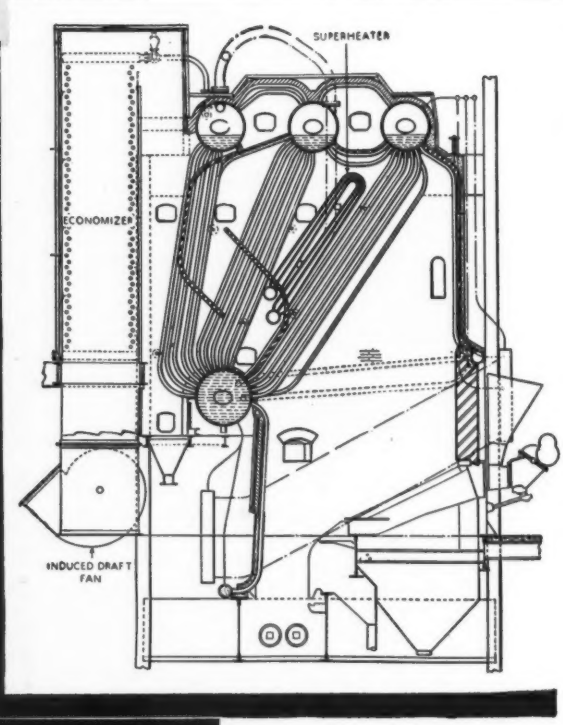
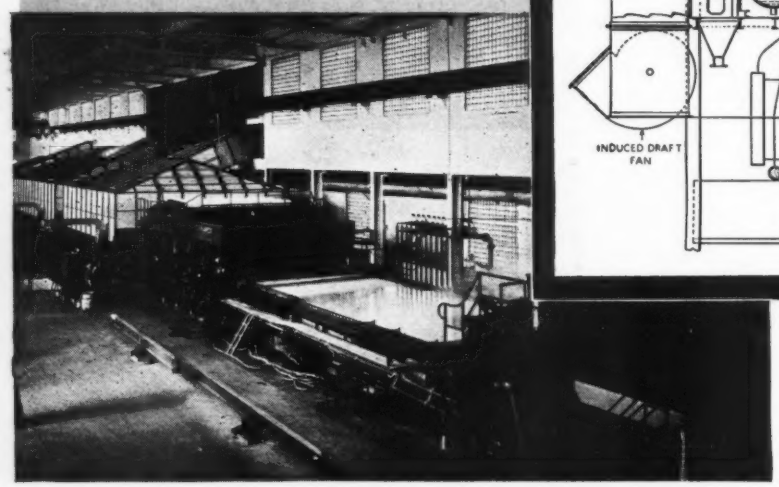
Cross-sectional view of B&W Stirling Boiler, equipped with Water-cooled Walls, and B&W Economizer. Capacity—100,000 lb. of steam per hour at 425 lb. pressure and 550 F. total temperature.



General view of "The Big Swede", world's largest glassine paper-making machine. It is 280 feet long, 182 inches wide, and has top production speed of 750 feet per minute.



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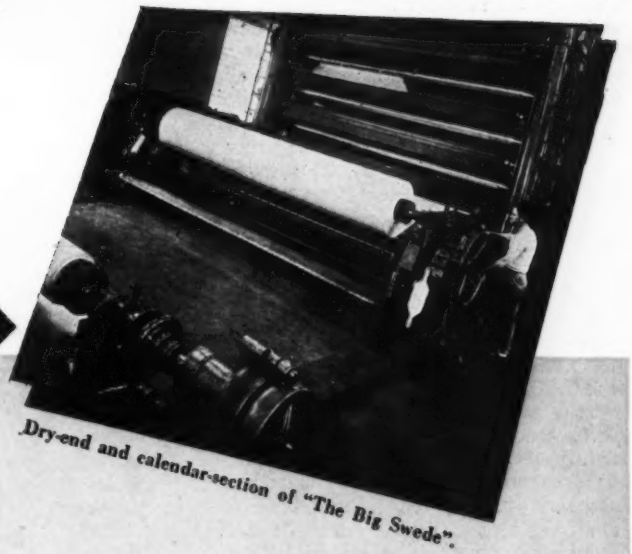

Dry-end and calendar-section of "The Big Swede".

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ations in the material itself. Highly permeable materials may be expected to show a deviation of 10% between different laboratories. Many of the objections to previous methods have been eliminated, especially those concerned with the following factors: method of sealing, edge leakage, test area, condensation, total pressure and vapor-pressure difference across the sheets, and the convection and diffusion rate of water vapor across an air space of various dimensions. The influence of the humidity range at constant vapor-pressure difference across the faces of the sheet and the influence of the testing temperature have not been fully evaluated.

Brabender, George J. Studies on water vapor permeability of paper containers for dry foods. Proc. 1st Food Conference, Institute of Food Technology 1:227-235 (1940); *C. A.* 35:2615.—Permeability increases at an accelerated rate with increasing temperature. Increasing the relative humidity at constant temperature always produces an increase in water vapor permeability. Sorbing materials, such as glassine and regenerated cellulose, increase in permeability at an accelerated rate with increasing relative humidity. Nonsorbing materials, such as cellulose acetate and rubber derivatives, show a straight-line relationship between water vapor permeability and relative humidity at constant temperatures.

Brabender, George J. Water vapor permeability. Progress report of the TAPPI Subcommittee on Water Vapor Permeability. *Paper Trade J.* 110, No. 18:27-30 (May 2, 1940); *Tech. Assoc. Papers* 23:358-361 (June, 1940); *Paper Ind.* 22, No. 8:838 (Nov., 1940); *B. I. P. C.* 10:393; *C. A.* 33:4027; 34:4264.—The text is given of a proposed TAPPI method for determining the water vapor permeability of paper and paperboard. This is now TAPPI Standard T 448 m-44. Some of the considerations leading to the adoption of the method are discussed.

Brabender, George J. Water vapor permeability of moisture sensitive materials. *Paper Trade J.* 119, No. 16:52-55 (Oct. 19, 1944); *Tech. Assoc. Papers* 27:473-476 (June, 1944); *B. I. P. C.* 15:103.—A composite sheet, such as moistureproof triple-ply glassine, offers particular difficulty in the determination of its water vapor permeability by accelerated methods. The cellulosic matter in such a sheet has a marked tendency to absorb water, whereas the two films of microcrystalline wax act as effective barriers to water-vapor transfer. This type of construction demands that special attention be paid to the factors of sheet distortion on the test cell, the prolonged period before the sheet reaches equilibrium with the testing conditions, and a low rate of change in weight because of traces of true water-vapor transfer. Precise control over the atmospheric conditions within the testing cabinet is of definite importance. Certain advantages in making permeability tests have been found by using a light weight test cell made as a shaped, seamless metal ring having two open faces. Test assemblies made up with such cells have a low gross weight, a small volume of confined air, occupy a small space in a cabinet, tend to minimize sheet distortion, and provide a fairly large test area. Ordinary rosin is not recommended as a component in the sealing medium for water vapor permeability tests because of its tendency to gain weight under high humidity and temperature conditions. This gain in weight is probably due to both oxidation and moisture absorption. Certain microcrystalline waxes and specially treated rosins have been found to be free from these defects and have other suitable properties for use in sealing compounds.

Carlson, Anders J., and Eastman, Max C. Factors influencing permeability measurements. *Am. Inst. Mining Met. Engrs., Tech. Publ.* No. 1196. 1940. 6 p. *C. A.* 34:5330.—An air permeameter is described. The method of cutting the sample and the condition of the surface exposed to air flow have little effect on measured values. Proper mounting is important. Turbulent flow conditions may be responsible for some reported discrepancies in results.

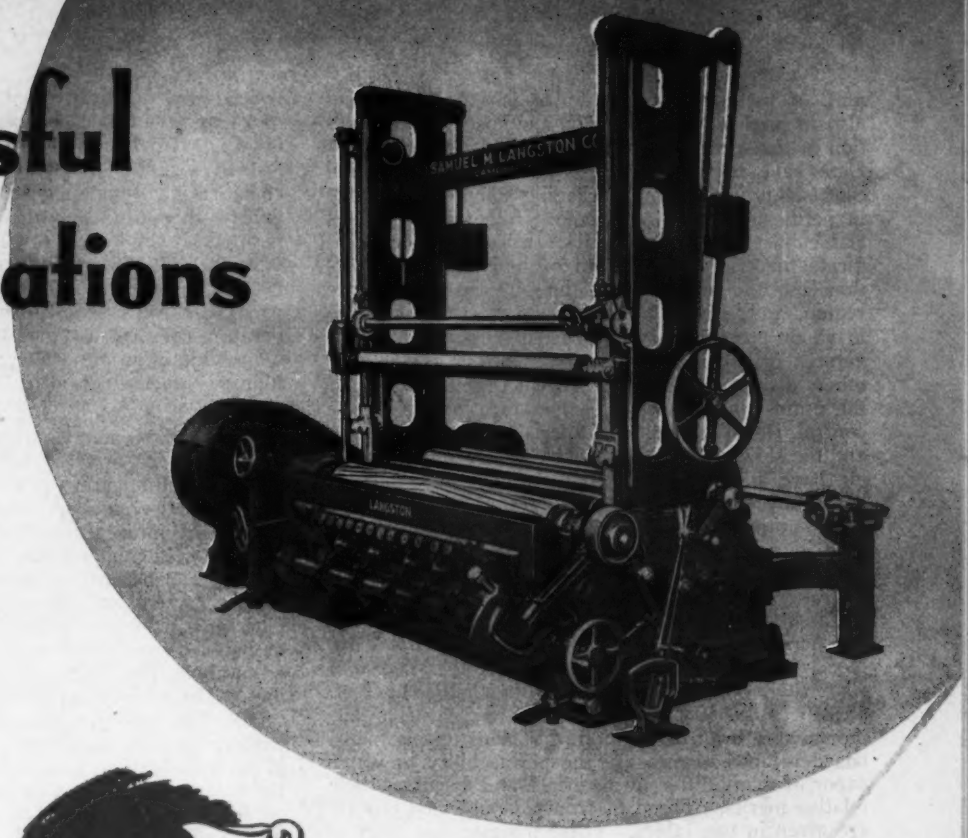
Carpenter, A. S., and Twiss, D. F. Measuring the permeability of rubber to various gases. *Ind. Eng. Chem., Anal. Ed.* 12, No. 2:99-108 (Feb., 1940); *C. A.* 34:3133.—The rate at which a gas passes through a sheet of rubber-like material and the rate at which a gas is absorbed by a block of the material are both dependent upon the same factors, solubility and diffusion constant. The magnitude of these factors can be measured by absorption experiments carried out under specified conditions and the results can be used to assess the permeability of the material in sheet form. Experimental methods and suitable apparatus are described for following absorption and the manner of interpreting the results in terms of permeability is given. Besides the advantage of accurate temperature control, convenient size, and ease of handling of the apparatus, the small size of the test pieces, and the elimination of the difficulty of producing uniform thin sheets free from pinholes,, the method has the advantage that both factors (solubility and diffusion constant) can be assessed independently; this is not normally possible with direct permeation measurements.

Carson, Frederick T. Notes on attaching a membrane to a water vapor permeability cell. *Paper Trade J.* 107, No. 18:59-61 (Nov. 3, 1938); *B. I. P. C.* 9:166; *C. A.* 33:859.—The specimen is supported in the mouth of a Petri dish or other form of permeability cell, while the circular edge is molded in wax, which makes a moisture-tight joint between the specimen and the cell. A templet which limits the flow of the wax is used to fix definitely and reproducibly the area of the specimen through which moisture is transmitted. The apparatus used in making such a seal is described. The specimen can be sealed in at any desired height in the cell; the seal is made with the cell in the upright position.

Carson, Frederick T. Passage of moisture through packaging material. *Food Ind.* 10, No. 1:14-16 (Jan., 1938); *B. I. P. C.* 8:350.—Theories of penetration of moisture through membranes or sheets are briefly discussed. The anomalous behavior of water vapor in penetration is mentioned. The important factors influencing a moisture penetration test are discussed—namely, time, area, leakage, thickness, vapor-pressure difference, relative humidity, temperature total pressure, diffusion in still air, and state of moisture.

Carson, Frederick T. Permeability of membranes to water vapor, with special reference to packaging materials. Natl. Bur. Standards, Misc. Publ. M 127. 19 p. Aug. 5, 1937. *T. S.* 107:230.—A study of data from about thirty sources in the literature shows that measurements of the permeability of membranes to water vapor have been made by four types of methods, with many modifications, and that the testing conditions have varied widely. The test period ranged from 2 to 2000 hours, the temperature from—14 to 45° C., the area of the specimen from 0.15 to 323 sq. cm., and the vapor pressure difference from 0 to 72

Successful Combinations



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mm. of mercury. Considerable variety was found also in methods of sealing on the specimen, ventilation of the specimen, and units expressing the results. Data have been reported in at least twenty units. Sheet materials used in packaging commodities range in permeability to water vapor from that of waxes and rubber to that of textile fabrics. The data indicate that the transpiration of moisture is proportional to the area, to the time in the steady-state region, and, within certain limits, to the difference in vapor pressure. It is reported by some to be inversely proportional to the thickness also, whereas others disagree. A seal to prevent edge leakage is of the utmost importance. Temperature requires close control. Relative humidity, especially at higher values, and the slowness of diffusion of water vapor through air have a marked influence in many cases. Suggested mechanisms of moisture transpiration include consideration of gaseous diffusion, diffusion of moisture in solid solution, movement of moisture as a function of the content of hygroscopic moisture, and migration of adsorbed water along surfaces.

Carson, Frederick T. Testing packaging materials for permeability to moisture. *Food Industries* 10, No. 3:130-132, 170 (March, 1938); *Paper Box and Bag Maker* 85, No. 5:180-190 (May 10, 1938); *C. A.* 33:243; *T. S.* 108:146; *B. I. P. C.* 8:396.—The author gives a brief description of various testing methods developed to measure the permeability to water vapor of many different materials, and discusses their relative merits. The data from 28 published reports are given in two tables. These indicate that there is no definite relationship between the permeability to to water vapor and to air.

Cartwright, L. C., [Cabinet for testing water vapor permeability.] *Tech. Assoc. Papers* 26:65-66 (June, 1943).—A description is given of a cabinet, three sides of which are double walled, plate glass constituting the inner wall and insulating fiberboard as the outer wall; the fourth side is a door consisting of a double wall of plate glass. The shelves are of half-inch mesh galvanized wire screen on square, welded frames of ⅜-inch iron rod. A fan draws air downward past the thermoregulator, blows it across the solution to maintain the humidity, past a lamp bank (three 25-watt lamps) to maintain the temperature, and then upward toward the test dish assembly which rests on the wire grid shelves with the test sheet downward. The test dish is an ordinary glass crystallizing dish, 80 cm. in diameter, with a ground edge. The test specimen is approximately 86 mm. in diameter. A suitable desiccant (e.g., anhydrous magnesium perchlorate) is placed in the crystallizing dish, the test specimen is placed over it; a glass ring is placed over this, lined up with the edge of the dish, and held firmly in place while a suitable sealing wax is run around the edges of the test specimen, sealing it firmly to the dish and the ring. The ring supports the test dish assembly on the grid shelf but permits free access of circulating air to the surface of the test sheet.

Charch, W. H., and Scroggie, A. G. Determination of water vapor permeability of cellulose wrapping materials. *Paper Trade J.* 101, No. 14:31-39 (Oct. 3, 1935); *C. A.* 30: 859; *T. S.* 103:191.—A detailed description is given of a test which has been found satisfactory for determining the permeability of water vapor of the most highly moistureproof wrappers (e. g., moistureproof cellophane). It is based on the exposure of a small dish, which contains water and is sealed tightly with the membrane to be tested, to a practically dry atmosphere for a period of 24 to 30 hours at constant temperature. The dish is weighed before and after this exposure, and the loss in weight is calculated to a standard basis for comparison. It is suggested that the method should give even more accurate results when used with wrappers exhibiting a high rate of moisture transmission. The factors influencing its accuracy are discussed. A thermostat is described which has a capacity for over 500 test dishes, will hold a given temperature constant within ±0.2° at any one point, and will maintain an atmosphere of less than 2% relative humidity over a period of days.

Cornwell, Ralph T. K. A new apparatus for determining the water vapor permeability of sheet materials. *Paper Trade J.* 120, No. 9:28-29 (March 1, 1945).—The apparatus consists of a modification of the Brabender moisture tester. It consists of a constant temperature cabinet through which air is circulated. The air intake and outlet are at one side and can be attached to a closed container holding the proper reagents to give a definite relative humidity. The air can be passed through a powerful desiccant or bubbled through water so that a relative humidity from about 0 to 100% can be maintained in the cabinet. The cabinet has space for ten test cups at one time. The cups are placed directly in the cabinet without previous weighing. After the cups have been in the oven for 5 to 10 minutes, they are suspended on the balance one at a time and the scale reading recorded; the weighings are repeated after about 0.5 hour and then after every hour until check results are obtained. Sufficient data can be obtained in a few hours to plot a straight line from which the computations can be made. The permeabilities obtained in this instrument agree very closely with those obtained under the same conditions by more cumbersome and lengthy techniques. With experience results can be obtained within an hour which are of value in controlling the manufacturing process.

Dalfsen, J. W. van. The permeability of rubber to water vapor. *Mededell. Nederland.—Ind. Inst. Rubberonderzoek, Buitenzorg* No. 36. 1941. 20 p. *Arch. Rubbercultuur* 25:483-502 (1941); *C. A.* 36: 5055.—The diffusion of water vapor through films of rubber was measured by a specially devised technique. A small glass cup containing water was placed on the rubber film, a glass cup (with its rim coated with asphalt) was placed upside down on the film, and the system inverted so that the water ran out of the inner cup into it, and the system was then placed in a desiccator containing silica gel, with its air in movement. By using salt solutions, diffusion at different vapor pressures could be measured. The permeability constant is characterized not only by the thickness of the film but also by the vapor pressure.

Doty, Paul M., Aiken, Wm. H., and Mark, Hermann. Water vapor permeability of organic films. *Ind. Eng. Chem., Anal. Ed.* 16, No. 11:686-690 (Nov., 1944); *B. I. P. C.* 15:137.—The diffusion cell of Schumacher and Ferguson is used; this is described and illustrated. The permeability of a film depends upon the diffusion constant and the solubility coefficient; the first measures the probability that each individual gas molecule will move in the direction of the concentration gradient and the second is a measure of the number of gas molecules per unit volume which contributes to this concentration gradient. The solubility coefficient does not include the water molecules that are sorbed but only those that are ideally

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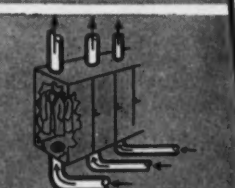
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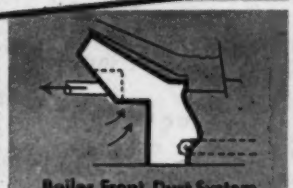
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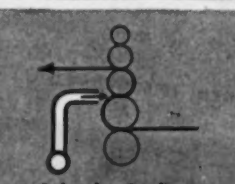
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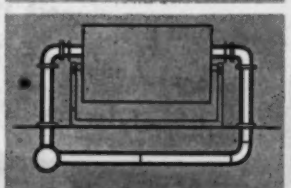
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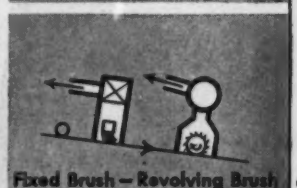
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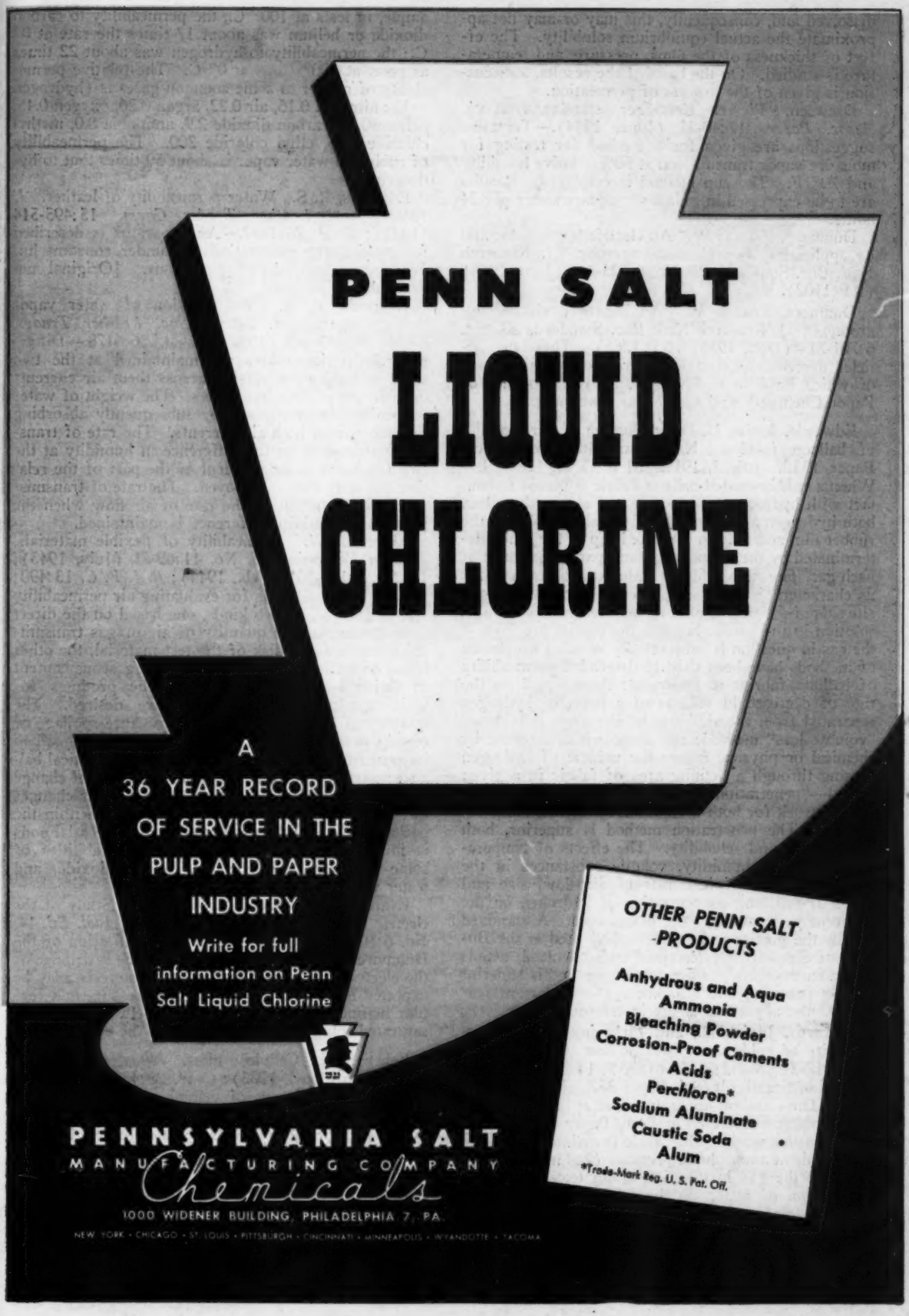
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dissolved and, consequently, this may or may not approximate the actual equilibrium solubility. The effect of thickness of the films, pressure, and temperature is studied. On the basis of the results, a discussion is given of the process of permeation.

Drewsen, Pierre. Container standards. *Tech. Assoc. Papers* 17:40-41 (June, 1934).—Tentative suggestions are given for a method for testing for moisture vapor transmission at 50% relative humidity and 70° F. The cup method is employed. Results are to be expressed in grams per square meter per 24 hours.

Dunmore, Francis W. An electric hygrometer and its application to radio meterography. J. Research Natl. Bur. Standards 20, No. 6:723-744 (June, 1938) (RP 1102).

Dunmore, Francis W. An improved electric hygrometer. J. Research Natl. Bur. Standards 23, No. 6:701-714 (Dec., 1939) (RP 1265).—These two articles describe an electric hygrometer, modifications of which have been developed at The Institute of Paper Chemistry and applied to containers.

Edwards, Junius D. Determination of permeability of balloon fabrics. Natl. Bur. Standards, Tech. Paper T113. July 2, 1918. 31 p. *C. A.* 12:1929.—When a rubber-coated balloon fabric is placed in contact with hydrogen on one side and air on the other, both hydrogen and the gases of the air dissolve in the rubber film and tend to saturate it up to the limits determinated by the temperature and partial pressure of each gas. The rubber film is penetrated by each gas at its characteristic speed and, when it reaches the opposite side of the rubber film, the gas evaporates from its solution in the rubber because the partial pressure of the gas in question is substantially zero. Two classes of methods have been used to determine permeability of balloon fabrics to hydrogen: those based on the rate of decrease in volume of a mass of hydrogen separated from the air by a definite area of fabric—"volume loss" method; and those which measure by chemical or physical means the volume of hydrogen passing through a definite area of fabric in a given period—"penetration" method. Apparatus and details of work for both methods are illustrated and described. The penetration method is superior, both in precision and reliability. The effects of temperature, pressure, humidity, volatile substances in the fabric, duration of test, rate of air flow, size and shape of cell, and concentration of hydrogen on the apparent permeability were determined. A standard test by the precise and rapid method used at the Bureau of Standards is described with operating details and calculations. The penetration method is superior both in precision and reliability. An important feature of the apparatus is the interferometer.

Edwards, Junius D., and Pickering, S. F. Permeability of rubber to gases. *Chem. Met. Eng.* 23, No. 1:17-21; No. 2:71-75 (July 7, 14, 1920). Natl. Bureau of Standards, Sci. Paper 387. July 12, 1920. 36 p.—The standard apparatus used at the Bureau of Standards and described in Tech. Paper 113 was employed in this work. The fabric is maintained at 25° C. with air at atmospheric pressure (760 mm.) on one side and the gas in question at an excess pressure of 30 mm. of water on the other side. The permeability to any gas is directly proportional to its partial pressure, provided the total pressure is constant. The permeability to hydrogen is inversely proportional to the thickness of the rubber. The temperature coefficient of permeability is quite high. For example, in tests at 100° C., the permeability to carbon dioxide or helium was about 17 times the rate at 0° C.; the permeability to hydrogen was about 22 times as great at 100° C. as at 0° C. The relative permeability of rubber to some common gases is (hydrogen =1): nitrogen 0.16, air 0.22, argon 0.26, oxygen 0.45, helium 0.65, carbon dioxide 2.9, ammonia 8.0, methyl chloride 18.5, ethyl chloride 200. The permeability of rubber to water vapor is about 50 times that to hydrogen.

Edwards, R. S. Water permeability of leather. *J. Intern. Soc. Leather Trades Chem.* 15:495-514 (1931); *C. A.* 26:1822.—An apparatus is described for making the penetration test under constant humidity and temperature conditions. [Original not available]

Edwards, R. S. Transmission of water vapor through leather. *J. Intern. Soc. Leather Trades' Chem.* 16:439-449 (1932); *C. A.* 26:6178.—Different relative humidities are maintained at the two faces of leather by passing across them air currents of different relative humidities. The weight of water transmitted is determined by subsequently absorbing the water from both air currents. The rate of transmission depends on the difference in humidity at the two faces and is independent of the part of the relative humidity range employed. The rate of transmission is independent of the rate of air flow when the prescribed humidity difference is maintained.

Elder, L. W. Permeability of flexible materials. *Modern Packaging* 16, No. 11:69-71 (July, 1943); 17, No. 6:100-101 (Feb., 1944); *B. I. P. C.* 13:490; 14:224.—The methods for evaluating air permeability are, in general, of two kinds, one based on the direct measurement of the quantity of air or gas transmitted through a flat disk of the test material, the other based on an analysis of the change in gaseous content of finished packages containing the products for which packaging specifications are desired. The quantity of fixed gases sufficient to cause spoilage of certain products is, unlike water vapor, too small to be measured by change in weight on an analytical balance; consequently, most methods make use of change in gas pressure, or chemical analysis to show changes in composition of the gaseous atmosphere within the package. An apparatus developed by General Foods is illustrated but not described. Permeabilities of some packaging films to air, carbon dioxide, and water vapor are reported.

Evans, R. N., and Davenport, J. E. Study of the electric hygrometer. *Ind. Eng. Chem., Anal. Ed.* 14, No. 6:507-510 (June, 1942).—A modification of the Dunmore hygrometer is described. The resistance of the electric hygrometer, if without hysteresis, may be expected to follow the water-vapor pressure in a regular manner except at a pressure below that of the saturated solution of the salt used as the electrolyte.

Fabel, Karl. Cellulose films. *Kunstseide* 15, No. 11:383-386 (Nov., 1933); *C. A.* 28:4223.—The permeability to moisture of cellophane films is determined by the cup method. The film is attached to a glass crystallizing dish (60 to 80 mm. in diameter and 35 to 45 mm. in height) by Picein (a bituminous sealing wax) and is dried at 90° C. Calcium chloride is used as the dehydrating agent. The determination is carried out at 30 ± 0.25° C.

Gardner, Henry A. Testing the permeability of films. *In his* Physical and chemical examination of paints, varnishes, lacquers, and colors, 9th ed., 1940, p. 239-240.—A general discussion. Descriptions are

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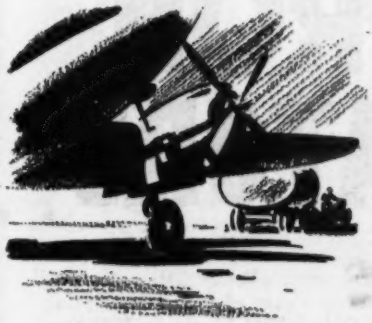

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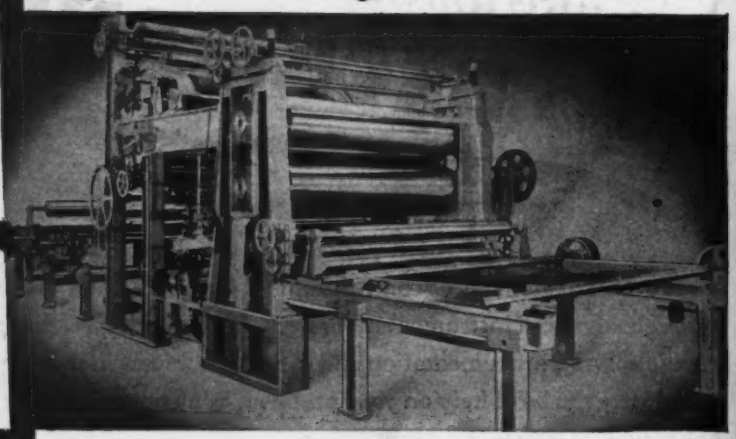

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given of the Cornwell, Payne, and Dold cups for permeability testing.

Graebner, W. H. Application of humidity equilibria to package engineering. *Fibre Containers* 29, No. 5:32, 34, 36-37 (May, 1944); *Modern Packaging* 17, No. 8:116C-116D (April, 1944); *B. I. P. C.* 14:381. —Two principles of package engineering are highly significant when introducing a topic like humidity equilibria: one is the fundamental that there is no single test which embraces all of the elements which make up a package and the second is the fact that quantitative factors of both product and packaging materials must be dealt with. It is not sufficient to state that a sheet material is moisture resistant or that a product is hygroscopic; if specific moisture equilibria data are supplied, the hygroscopic nature of the product has been reduced to quantitative terms, even if this represent only one segment of the over-all picture of packaging engineering. The author describes the apparatus and method for preparing the humidity equilibria data, employing the Dunmore hygrometer. The product under investigation is exposed to known relative humidities and weighed periodically until constant weight is established. The data thus secured are plotted, giving the humidity equilibrium curve characteristic for this product. This curve must be supplemented by two additional factors: the optimum moisture content and the index of failure. This will give an indication of the amount of protection required by the product. Caution must be used in transferring data obtained from tests on flat sheets to the finished package. Such tests should always be supplemented with packaging tests.

Gregory, James. Transfer of moisture through fabrics. *J. Textile Inst.* 21:T66-84 (1930).—The method of test consists in measuring (by weighing) the rate of escape of water vapor into an air-conditioned room from a shallow glass vessel covered with a layer of the fabric, the water in the dish being maintained at the desired temperature by a surrounding water bath. Standard test conditions were a water surface at 37.5° C. through the fabric into free still air at 20.5° C. and 63% relative humidity. The time employed is not more than 4 hours.

(To be Continued)

National Container Plans Expansion

LONG ISLAND CITY, N. Y., September 22, 1945—A capital expenditure has been authorized to increase the capacity of the recently acquired subsidiary, Ontonagon Fibre Corp. of Ontonagon, Mich., which, when completed, will increase the capacity of the kraft, pulp and board mill of this division substantially and reduce further unit cost.

A similar program is simultaneously being carried out at the Big Island, Va., mills of the subsidiary, Bedford Pulp and Paper Company, Inc., where production likewise will increase substantially with resulting marked improvement in quality together with lowering of unit cost. It is expected that the new equipment being installed in this division under this program will be completed and in operation within the next 30 days.

Epstein Will Visit Mills

BOSTON, Mass., September 24, 1945—Harry T. Epstein, of the Paper Products Company, is planning to take a business trip to the West early in October, expecting to visit paper mills and paper converters. He will return in the latter part of the month.

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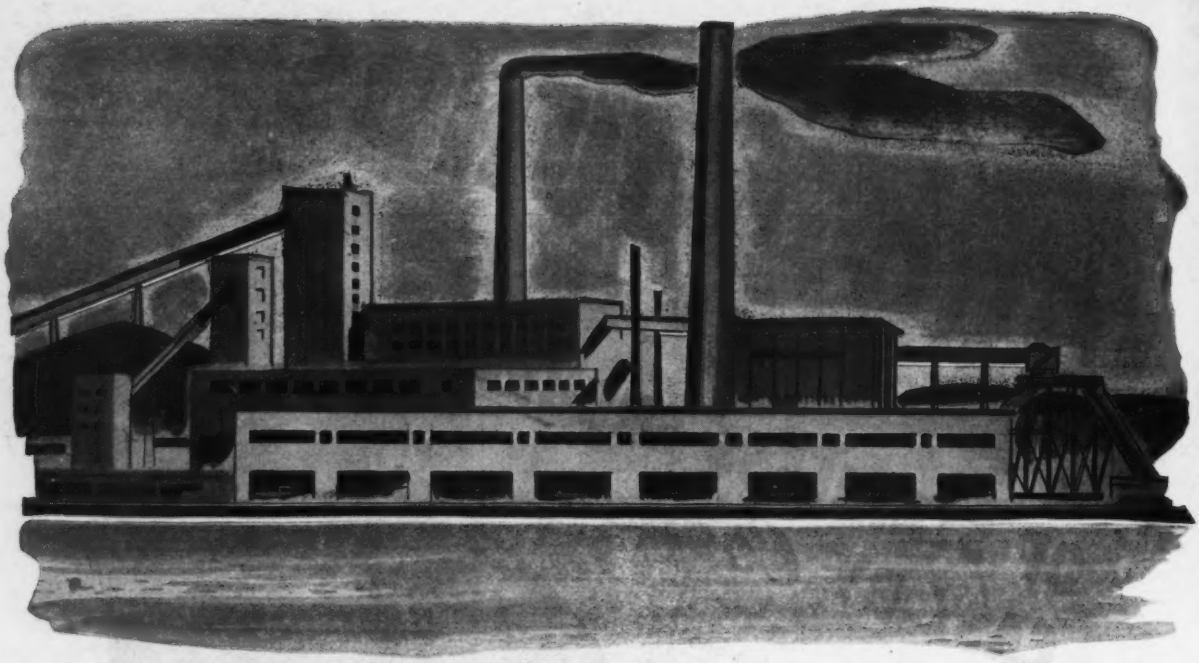
- Improved cleaning . . . including Lustracast electrolytic finishing which leaves all surfaces bright.
- Castings furnished rough, polished or fully machined . . . one ounce to two tons.
- Development of special alloys to meet unusual requirements.
- Technical consulting service.
- Zyglo detection of surface imperfections.

THE *Cooper* ALLOY FOUNDRY CO.

STAINLESS • MONEL • NICKEL



WHAT GOES ON IN THIS PAPER MILL...

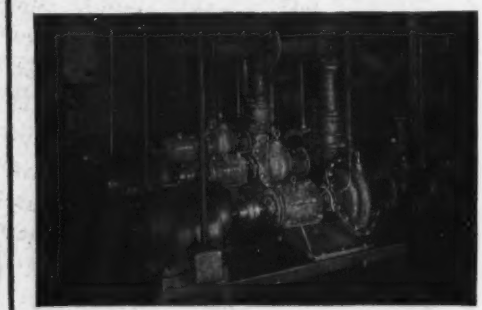
in addition to making paper?

Many paper mills today are *also* turning out chemical by-products of wood . . . such as tall oil, alcohol, resins, turpentine used in the manufacture of soaps, plastics, paints — to name a few. What new kinds of by-products will be made in paper mills of the future can't be said for sure right now.

What *is* certain is that the processing of chemical by-products calls for the right pumps — often specially-developed pumps — such as Worthington builds now . . . and *will* engineer to solve your future problems.

Worthington P.A.E.'s* offer the most in experience and know-how of pump application for all types of pulp and process problems. Worthington offers all types and sizes of centrifugal pumps to *overcome* these corrosion, abrasion, heat viscosity and solidification problems. If you need the right pumps now . . . or will need them after the war, you'll learn that *there's more worth in Worthington* by phoning our nearest office or writing to— *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

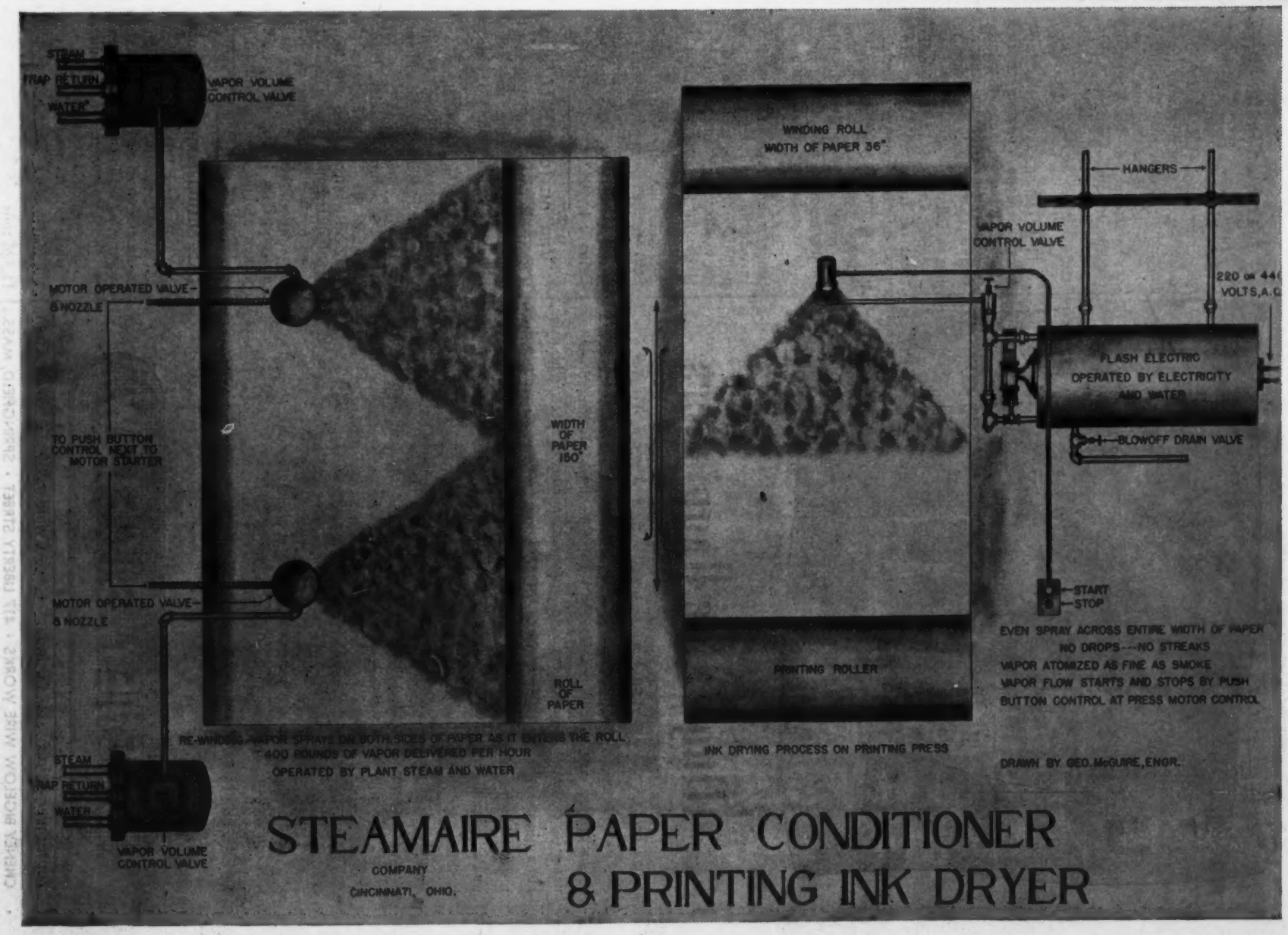
*P.A.E.—Pump Application Engineer.



3 of 6 Worthington thin Black Liquor Pumps in the Diffuser House of the North Carolina Pulp Company, Plymouth, N. C.

WORTHINGTON

THE WORLD'S LARGEST MANUFACTURER OF PUMPS


STEAM
TRAP RETURN
WATER
VAPOR VOLUME CONTROL VALVE
MOTOR OPERATED VALVE & NOZZLE
TO PUSH BUTTON CONTROL NEXT TO MOTOR STARTER
MOTOR OPERATED VALVE & NOZZLE
WIDTH OF PAPER 150"
ROLL OF PAPER
RE-WINDING
VAPOR SPRAYS ON BOTH SIDES OF PAPER AS IT ENTERS THE ROLL
400 POUNDS OF VAPOR DELIVERED PER HOUR
OPERATED BY PLANT STEAM AND WATER
STEAM
TRAP RETURN
WATER
VAPOR VOLUME CONTROL VALVE
WINDING ROLL
WIDTH OF PAPER 36"
PRINTING ROLLER
INK DRYING PROCESS ON PRINTING PRESS
HANGERS
VAPOR VOLUME CONTROL VALVE
220 or 44
VOLTS, A.C.
FLASH ELECTRIC
OPERATED BY ELECTRICITY AND WATER
BLOWOFF DRAIN VALVE
START
STOP
EVEN SPRAY ACROSS ENTIRE WIDTH OF PAPER
NO DROPS---NO STREAKS
VAPOR ATOMIZED AS FINE AS SMOKE
VAPOR FLOW STARTS AND STOPS BY PUSH BUTTON CONTROL AT PRESS MOTOR CONTROL
DRAWN BY GEO. McGUIRE, ENGR.
STEAMAIRE COMPANY
CINCINNATI, OHIO.
STEAMAIRE PAPER CONDITIONER & PRINTING INK DRYER

HISTORICAL HIGHLIGHTS OF PAPERMAKING NO. 18

King of the Ragpickers

Ragpickers are and always were important to the paper industry.

One of these vital contributors, whose name (so far as we can discover) kind history has withheld, was honored and respected by his fellow ragpickers. Born in Paris, France in 1767, he became a well-educated and wealthy man. But he squandered his money and simultaneously fell down the ladder of society until he reached bottom. There he found a welcome niche among the ragpickers.

Until his death, his comrades-in-rags reserved a number of streets in his name. Only he was allowed to venture there on picking excursions. In addition, they gave him a monthly allowance of pocket money for his gin and tobacco. He died in 1858 at the age of 91. The funeral was largely attended by ragpickers.

☆ ☆ ☆ ☆

Although serving the paper industry in a different manner, we at Cheney Bigelow do our best to earn the position we occupy. We supply the paper industry with the best in Fourdrinier wires, dandy rolls, cylinders and pulp-and-paper-mill wire cloth.

CHENEY BIGELOW

Fourdrinier Wires · · Dandys · · Cylinders · · Wire Cloth

CHENEY BIGELOW WIRE WORKS · 417 LIBERTY STREET · SPRINGFIELD, MASS.

To Stop Pollution

WASHINGTON, D. C. September 20, 1945—Representative Bailey, W.Va., has introduced H.R. 3972, a bill "to encourage the prevention of stream pollution by allowing amounts paid for plants for the treatment of industrial waste as a deduction in computing net income." The bill, which has been referred to the House Committee on Ways and Means, is as follows:

That section 23 of the Internal Revenue Code (relating to deductions allowed in computing net income) is amended by inserting at the end thereof a new subsection reading as follows:

"(bb) Cost of Plants for Treatment of Industrial Waste.—In the case of a taxpayer discharging (either directly or through public sewage systems) industrial waste into rivers or streams in the United States, amounts paid during the taxable year for the construction of facilities (approved by the applicable State or interstate authority having jurisdiction with respect to stream pollution) for the treatment of such waste, including amounts paid for plans for such construction and treatment."

Sec. 2. The amendment made by this Act shall be applicable only with respect to taxable years beginning after December 31, 1945, and before January 1, 1952.

Vaughn Joins B-D Pulp

The appointment of Edward B. Vaughan to the sales staff of the Bulkley, Dunton Pulp Co. has been announced by Fred Enders, president. Mr. Vaughan will make his headquarters in Bulkley, Dunton's New York office at 295 Madison Avenue.

Prior to joining Bulkley, Dunton, and for the past 12 years Mr. Vaughan was connected with the International Paper Co. He became associated with the Southern Kraft Corporation, then a subsidiary of International, in 1933, and was active in their Mobile, Alabama mill both in the operating and sales departments.

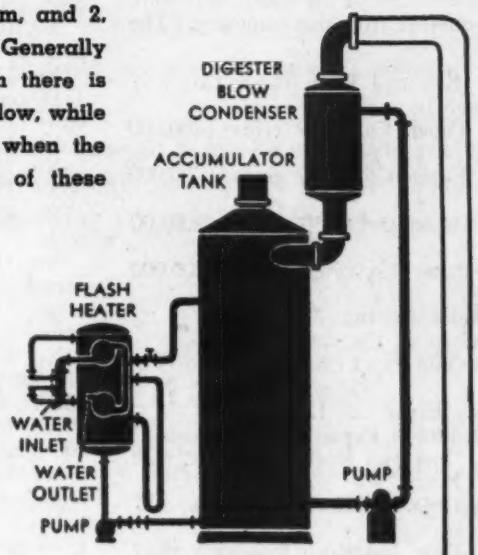
Argentina Exports Casein

WASHINGTON, D. C., September 22, 1945—Argentina's production of casein amounted to 1,745 metric tons in June, according to a report reaching the Department of Commerce. Stocks totaled 13,664 tons on June 1, while exports were 3,764 tons for the month.

Stocks on July 1 were shown as 11,526 tons.

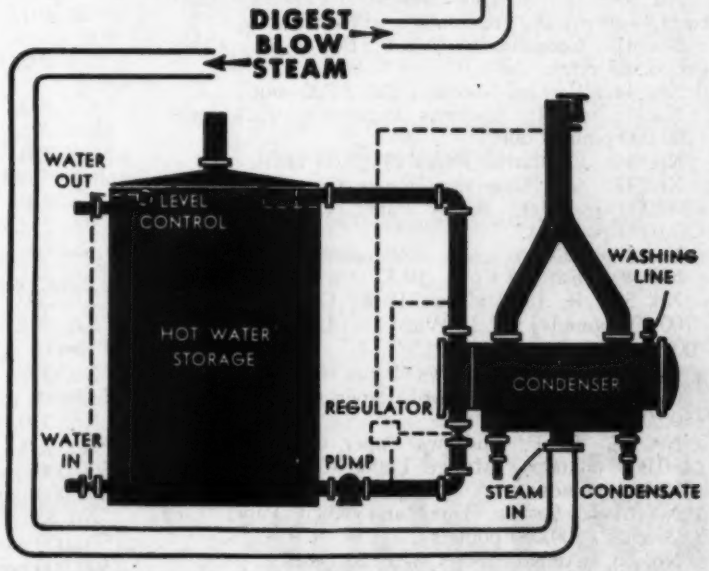
HEAT RECOVERY SYSTEMS FOR DIGESTER BLOW

Two methods to recover heat from digester blow are: 1, the Vapor-Liquid Recovery System, and 2, the Surface Condenser Recovery System. Generally speaking, the former is advisable when there is appreciable carry-over of pulp from the blow, while the latter unit is best adapted for use when the steam is relatively clean. Advantages of these systems are:



VAPOR-LIQUID →

1. *Optimum heat recovery . . . approximately 9% more than with surface type.*
2. *Heating surfaces cannot be plugged with pulp.*



SURFACE-CONDENSER →

1. *Simplicity of system.*
2. *Ability to handle blows from many digesters, providing they do not overlap to exceed design ratings.*

●

Foster Wheeler designs and builds these systems and has both types in successful operation. Performance records show that the units pay for themselves within a period of 12 months.

FOSTER WHEELER CORPORATION • 165 BROADWAY, N. Y. 6, N. Y.

FOSTER WHEELER

Joint Congressional Committee Makes Awards for Government Paper

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., September 24, 1945—Awards were made today by the Joint Congressional Committee on printing for paper for the use of the Government Printing Office for the three months' period beginning October 1. When the proposals were opened September 17, bids were received on only those numbers recorded last week. Those specifications on which no bids were received or on which bids were rejected have been omitted from this summary. The awards follow.

No. 4. Barton, Duer and Koch Paper Co., 7.97 cents (200,000 pounds).

No. 6. Mudge Paper Co., 7.59 cents (200,000 pounds).

No. 7. Mudge Paper Co., 7.59 cents (200,000 pounds).

No. 8. Mudge Paper Co., 7.59 cents (200,000 pounds).

No. 9. Mudge Paper Co., 7.59 cents (200,000 pounds).

No. 10. Mead Sales Co., Inc., 7.46 cents.

No. 19. Paper Corp. of U. S., 9.27 cents.

No. 20. Central Ohio Paper Co., 8.13 cents (150,000 pounds).

No. 26. Whitaker Paper Co., 17.10 cents.

No. 34. R. P. Andrews Paper Co., 7.33 cents.

No. 37. Barton, Duer and Koch Paper Co., 6.32 cents.

No. 38. Barton, Duer and Koch Paper Co., 5.87 cents.

No. 39. Barton, Duer and Koch Paper Co., 5.87 cents.

No. 41. Consolidated Water, Power and Paper Co., 6.565 cents.

No. 44. Perkins-Goodwin Co., 5.725 cents.

No. 45. R. P. Andrews Paper Co., 7.24 cents (200,000 pounds only)

No. 46. Cauthorne Paper Co., 8.35 cents.

No. 47. Old Dominion Paper Co., 10.18 cents (200,000 pounds); Aetna Paper Co., 9.93 cents (200,000 pounds).

No. 48. Eastern Corp., 9.60 cents.

No. 49. Eastern Corp., 10.33 cents.

No. 50. R. P. Andrews Paper Co., 12.83 cents (100,000 pounds); D. L. Ward Co., 12.79 cents (50,000 pounds).

No. 55. R. P. Andrews Paper Co., 7.82 cents (200,000 pounds); Stanford Paper Co., 7.87 cents (500,000 pounds).

No. 57. R. P. Andrews Paper Co., 7.59 cents (450,000 pounds); Mudge Paper Co., 7.615 cents (200,000 pounds).

No. 61-2. Barton, Duer and Koch Paper Co., 8.83 cents (500,000 pounds).

No. 63. Aetna Paper Co., 12.33 cents.

No. 65. Aetna Paper Co., 14.98 cents.

No. 66. Mudge Paper Co., 20.36 cents (no. 32); 18.86 cents (no. 40) (155,000 pounds); Barton, Duer and Koch Paper Co., 18.25 cents (50,000 pounds).

No. 68. Franklin Research Co., 19.425 cents.

No. 75. Barton, Duer and Koch Paper Co., 27.00 cents.

No. 76. Old Dominion Paper Co., 21.997 cents (60,000 pounds).

No. 85. Barton, Duer and Koch Paper Co., 27.00 cents (80,000 pounds).

No. 105. Aetna Paper Co., 17.65 cents.

No. 106. R. P. Andrews Paper Co., 14.18 cents (200,000 pounds); Whitaker Paper Co., 14.18 cents (100,000 pounds); Bulkley, Dunton and Co., 14.18 cents (200,000 pounds); Central Ohio Paper Co., 14.18 cents (100,000 pounds).

No. 107. Wilcox-Walter-Furlong Paper Co., 14.18 cents (150,000 pounds); Cauthorne Paper Co., 14.18 cents (150,000 pounds); Aetna Paper Co., 14.39 cents (300,000 pounds).

No. 108. Aetna Paper Co., 14.39 cents (600,000 pounds).

No. 110. Walker Goulard Plehn Paper Co., Inc., 15.00 cents (50,000 pounds); Aetna Paper Co., 15.09 cents (150,000 pounds).

No. 111. Aetna Paper Co., 15.09 cents.

No. 151. Eastern Corp., 9.60 cents.

No. 152. Eastern Corp., 9.50 cents.

No. 153. Wilcox-Walter-Furlong Paper Co., 8.95 cents.

No. 154. Aetna Paper Co., 14.39 cents (350,000 pounds).

No. 155. Aetna Paper Co., 14.39 cents (150,000 pounds).

No. 177. R. P. Andrews Paper Co., 28.13 cents (50,000 pounds); Barton, Duer and Koch Paper Co., 26.50 cents (50,000 pounds).

No. 184. Whitaker Paper Co., 7.67 cents (150,000 pounds).

No. 189. Walker Goulard Plehn Co., Inc., 15.00 cents.

No. 190. Barton, Duer and Koch Paper Co., 15.67 cents.

No. 191. Barton, Duer and Koch Paper Co., 16.67 cents.

No. 192. Walker Goulard Plehn Co., Inc., 15.75 cents.

No. 203. Whitaker Paper Co., 8.40 cents.

No. 205. Whitaker Paper Co., 14.90 cents.

No. 210. Whitaker Paper Co., 5.905 cents (4¾" rolls); 5.655 cents (5¾ and 7½" rolls).

No. 218. R. P. Andrews Paper Co., 4.90 cents.

No. 252. Old Dominion Paper Co., $14.727 per M sheets.

No. 271. Paper Corp. of U. S., 8.65 cents.

No. 280. Mudge Paper Co., 10.25 cents.

No. 301. Old Dominion Paper Co., $33.997 per M sheets.

No. 305. Old Dominion Paper Co., $67.878 per M sheets.

No. 310. R. P. Andrews Paper Co., 9.25 cents.

No. 325. R. P. Andrews Paper Co., 6.17 cents (500,000 pounds); Whitaker Paper Co., 622 cents (200,000 pounds)

No 326. R. P. Andrews Paper Co., 6.17 cents (500,000 pounds); Whitaker Paper Co., 6.22 cents (500,000 pounds).

No. 327. R. P. Andrews Paper Co., 6.17 cents (500,000 pounds); Whitaker Paper Co., 6.22 cents (500,000 pounds).

No. 351. R. P. Andrews Paper Co., $7.15 per C sheets.

No. 360. Whitaker Paper Co., 3.03 cents.

No. 366. Mathers-Lamm Paper Co., 4.546 cents.

No. 368. Consolidated Paper Co., 5.87 cents.

No. 369. Mead Sales Co., Inc., 4.00 cents (caliper 60 points and up); 4.375 cents (caliper 50 points).

How to Get More out of Your Chemicals

By maintaining constant vigilance in manufacturing and shipping uniformly high quality chemicals, we have endeavored to serve the pulp and paper industry. You can always depend upon Hooker for the quality you want in pulp and paper chemicals.

Another way that Hooker has been helping pulp and paper makers is through the services of its Technical Staff. The close cooperation of Hooker chemists with pulp and paper makers is well known in the industry. The results of this relationship are found in the technical papers and bulletins Hooker has printed and offers to all those interested. These bulletins suggest the way to improved processes, greater economies and higher quality production for you.

They cover many phases of your operations and should be of value to your present operations as well as for your post-war planning. Some of the Hooker bulletins of interest to the paper industry are listed below. Copies will be sent you when requested on your letterhead.

HOOKER BULLETINS

BULLETIN 201—*Process and Equipment for Making Bleach for Use Without Settling.*

BULLETIN 208—*Prevention of Suck-backs in Chlorine lines.*

BULLETIN 211—*Chemistry of Bleaching Chemical Wood Pulps.*

BULLETIN 234—*Lime-Chlorine System in Preparation of Calcium Hypochlorite.*

BULLETIN 236—*Importance of pH and Catalysts in Bleachery Operations.*

BULLETIN 241—*Bleaching Gumwood Sulfate Pulp.*

BULLETIN 242—*Production and Use of Unsettled Bleach Liquor.*

BULLETIN 243—*Procedures and Brightness Grades in Bleaching Sulfate Pulps.*

HOOKER ELECTROCHEMICAL COMPANY

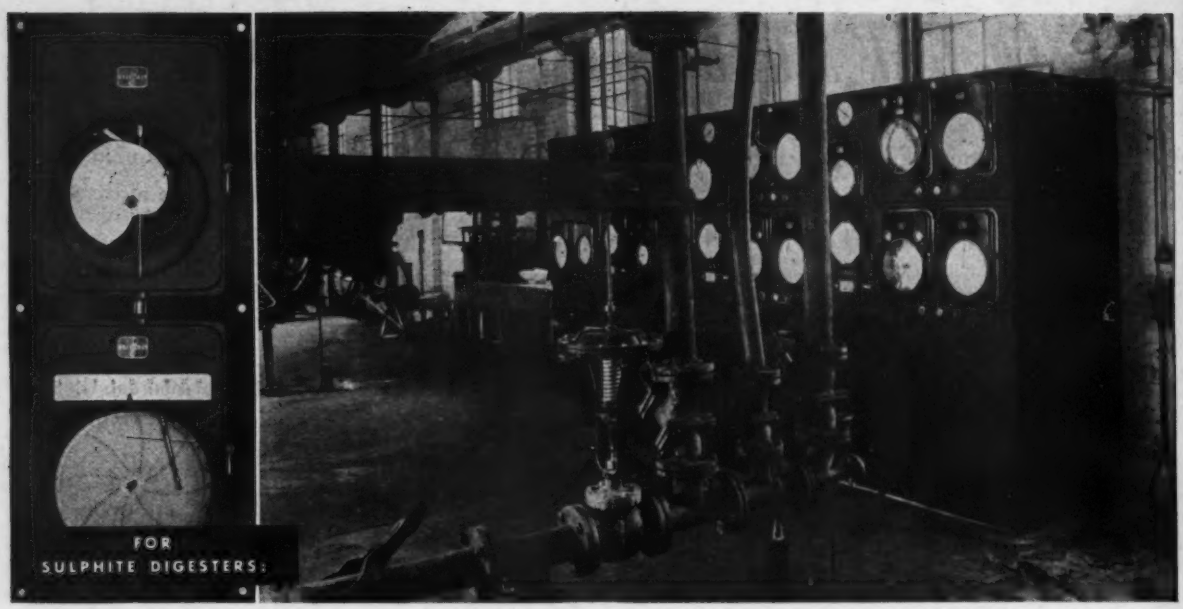
4 Union St. NIAGARA FALLS, N. Y.

New York, N. Y. Wilmington, Calif. Tacoma, Wash.

HOOKER CHEMICALS

Caustic Soda Chlorine Muriatic Acid Sodium Sulfide Bleaching Powder

8434



A Potentiometer-Type Time-Temperature Controller

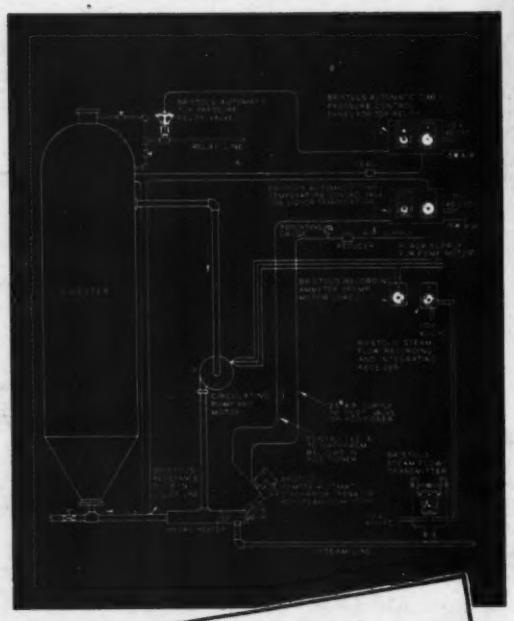
that is both *Sensitive* and *Rugged*

Since chips are cooked to time pressure and temperature alone, it is vital to have continuous and accurate recordings and control.

Bristol's Pyromaster Time-Temperature Recorders and Controllers provide the sturdiness which earlier potentiometer-type instruments lacked for this service. Construction is greatly simplified . . . all parts are accessible even when in operation . . . there are no continuously-moving parts to require frequent lubrication . . . accuracy is not affected by plant vibrations . . . and a high-torque motor is utilized for ruggedness.

In the Pyromaster Controller used with circulating systems, a metal disk, shaped to the desired control curve, is mounted on the shaft of a synchronous motor. A cam follower continuously resets the control point of the controller to agree with the control curve, thus assuring liquor temperatures exactly as specified.

Write for more information on Bristol instruments for sulphite digesters.



Complete direct-heated circulating system for sulphite digesters, equipped with Bristol Instruments.

THE BRISTOL COMPANY, 159 Bristol Road
WATERBURY 91, CONN.

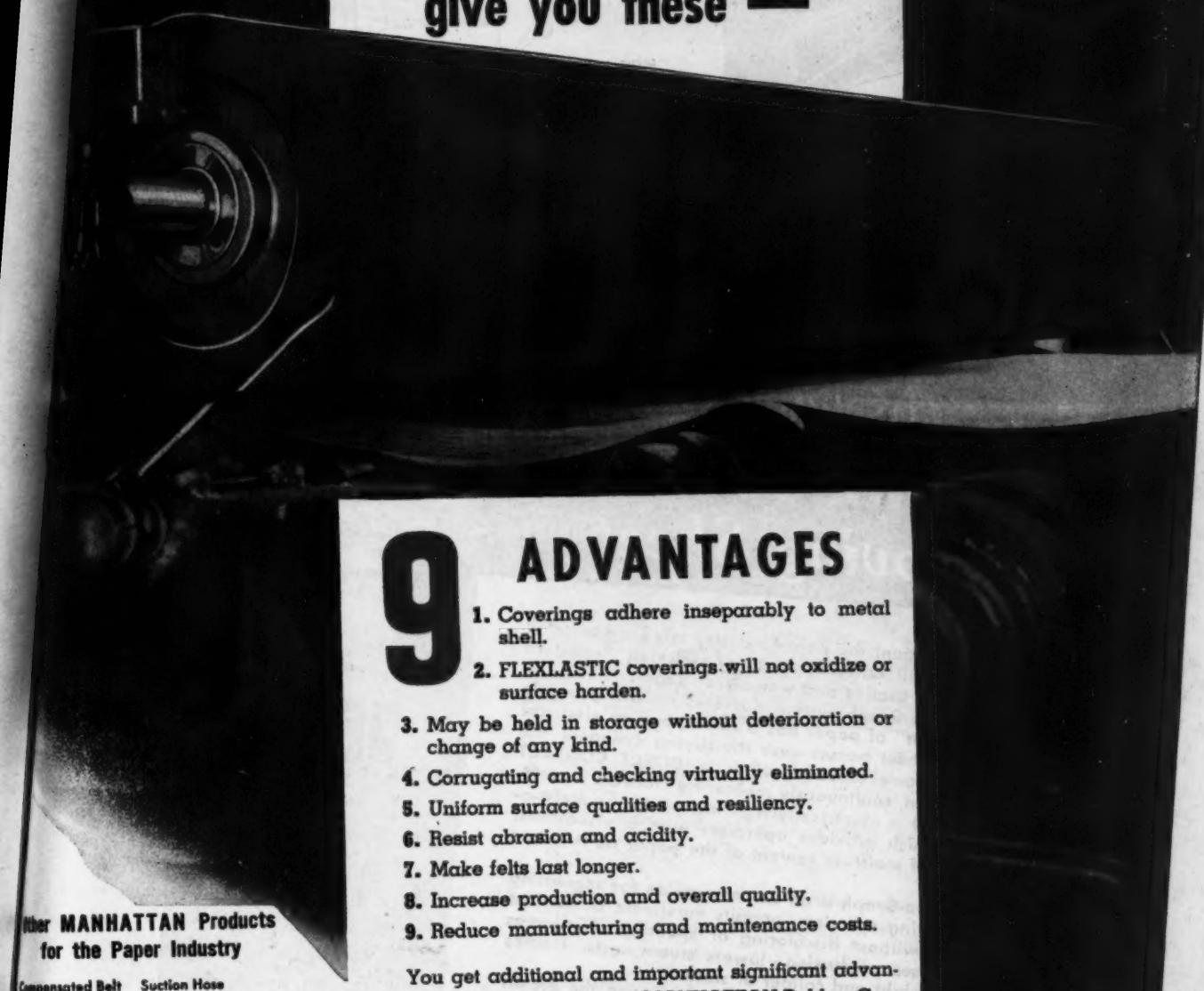
The Bristol Co. of Canada, Ltd.
Toronto, Ontario

Bristol's Instrument Co., Ltd
London N. W. 10, England

Explosive Pressure Control for Better Products and Profits

AUTOMATIC CONTROLLING AND RECORDING INSTRUMENTS

All MANHATTAN Rubber Covered Rolls give you these —



9 ADVANTAGES

1. Coverings adhere inseparably to metal shell.
2. FLEXLASTIC coverings will not oxidize or surface harden.
3. May be held in storage without deterioration or change of any kind.
4. Corrugating and checking virtually eliminated.
5. Uniform surface qualities and resiliency.
6. Resist abrasion and acidity.
7. Make felts last longer.
8. Increase production and overall quality.
9. Reduce manufacturing and maintenance costs.

You get additional and important significant advantages in specific types of MANHATTAN Rubber Covered Rolls—like Couch rolls with sealed ends; suction press and extractor rolls; Rub-Roc water repellent Top Press and Marblex Table Rolls that eliminate galvanic action and do not carry surface water.

MANHATTAN Red Rubber Couch Rolls—"Sealed Ends" prevent rubber cover becoming loose or flared at roll ends.

Other MANHATTAN Products for the Paper Industry

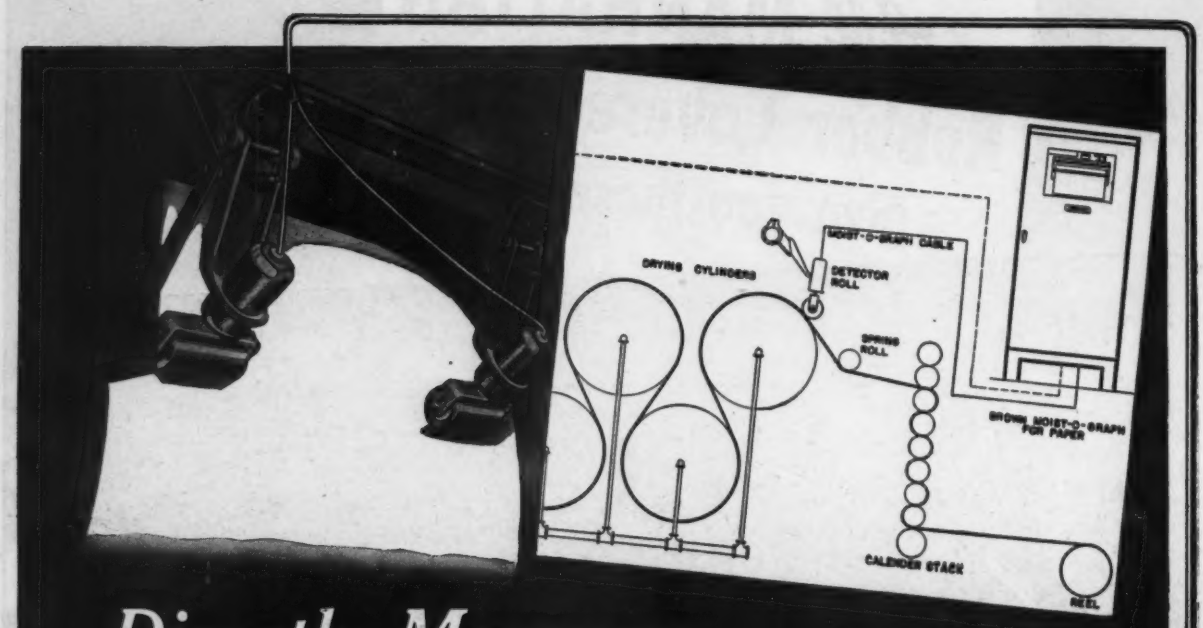
Compensated Belt	Suction Hose
Conveyor and Elevator Belt	Water Hose
V-Belt	Paper Mill Hose
Agricultural Belt	Molded Rubber Goods
Air Hose	Oilless Bearings
Acid Hose	Screen Diaphragms
Fire Hose	Rubber Covered Rolls
Steam Hose	Printing Ink Rollers

The term FLEXLASTICS is an exclusive MANHATTAN trade mark. Only MANHATTAN can make FLEXLASTICS. Rubber Covered Rolls are now made in the dark, wartime color.

THE MANHATTAN RUBBER MFG. DIVISION

OF RAYBESTOS-MANHATTAN, INC.

Executive Offices and Factories PASSAIC, NEW JERSEY



Directly Measures MOISTURE CONTENT *of Moving Sheet*

HERE'S the instrument the paper industry has long awaited—it outmodes all other methods of checking *"moisture content"* for all grades and weights of paper.

The Brown *Moist-o-Graph* system operates on the principle that *"moisture content"* of paper has a corresponding electrical resistance. As the sheet passes over the drying cylinders—the *Moist-o-Graph* electronic detector roll is in DIRECT CONTACT with the moving sheet, continuously measuring moisture content.

This measurement is electrically transmitted to the *Moist-o-Graph* recorder, which provides operators with a visual and permanent record of *moisture content* of the paper as it comes off the machine.

The Brown *Moist-o-Graph* is an accurate guide for regulating heat supply to drying cylinders—permits maximum amount of water to be held without discoloring or spoilage. Eliminates overdrying—increases production—lowers steam costs. Insures uniform quality, weight and caliper of stock.

Years of research, design and tests have proven the Brown *Moist-o-Graph* the ideal instrument for determining and holding the correct moisture content of Book, Bond, Ledger, Coated, News, Cardboard, Box Board, Capacitor Tissue, and Kraft papers.

Learn more about the Brown *Moist-o-Graph* system. Write for Bulletin 28-8. THE BROWN INSTRUMENT COMPANY, *a division of Minneapolis-Honeywell Regulator Co.*, 4510 Wayne Avenue, Philadelphia 44, Pa. Offices in all principal cities. Toronto, Canada: 117 Peter Street—England: Wadsworth Road, Perivale, Middlesex—Stockholm, Sweden: Nybrokajen 7.

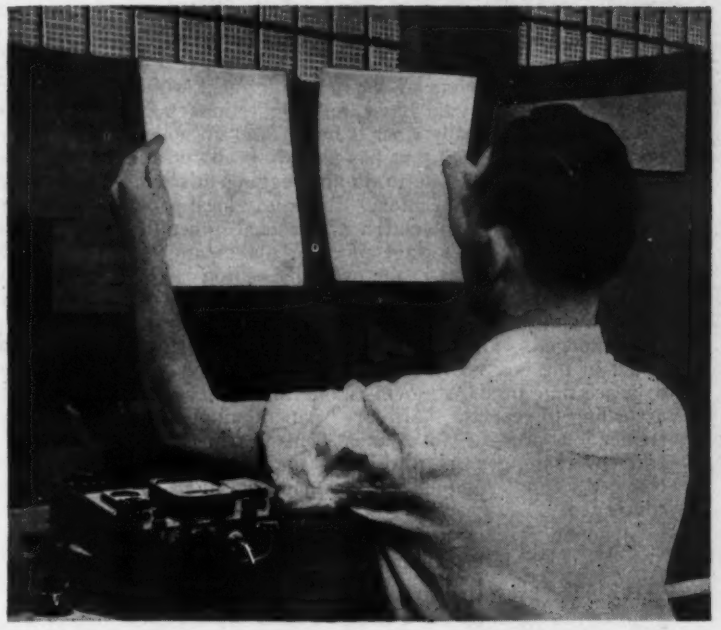
BROWN MOIST-O-GRAPH

SPECIFY "GENERAL CHEMICAL"

...improve formation—appearance—quality

Visual as well as laboratory testing of paper formation establishes the necessity for using a pure, uniform "Alum" in manufacturing a high-grade sheet.

General Chemical Aluminum Sulfate—as well as the Company's other paper-making chemicals—is made with strict attention to every production detail. Constant laboratory control assures product uniformity and purity. For "Alum" you can rely upon, specify **General Chemical:**



aluminum sulfate

Standard—Lump; Ground, 99% thru 8 mesh, 95% thru 10 mesh; Powdered, 95% thru 100 mesh.

Iron Free—Lump, approx. 2½"; Ground, thru 8 mesh.

sodium silicate

Solutions: From 38°—60° Baume — Wt. Ratio (Na_2O to SiO_2) from 1:2.00—1:3.40

Appearance: Opalescent to clear.

GENERAL CHEMICAL COMPANY products for the paper industry

Aluminum Sulfate (Standard and Iron Free) • Copper Sulfate • Muriatic Acid (Hydrochloric) • Sodium Fluoride • Sodium Silicate • Sodium Metasilicate • Glauber's Salt (Crystal or Anhydrous) • Salt Cake Sodium Sulfide • Sodium Hyposulfite • Sodium Sulfite (Anhydrous) Sodium Bisulfite (Solution or Anhydrous) • Disodium Phosphate Trisodium Phosphate • Tetrasodium Pyrophosphate • Sulfuric Acid Nitre Cake (Sodium Bisulfate) • Nitric Acid

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GENERAL CHEMICAL COMPANY
FOR AMERICAN INDUSTRY

GENERAL CHEMICAL COMPANY
40 RECTOR STREET, NEW YORK 6, N. Y.

Sales and Technical Service Offices: Atlanta • Baltimore • Boston • Bridgeport (Conn.) Buffalo • Charlotte (N. C.) • Chicago • Cleveland • Denver • Detroit • Houston • Kansas City • Los Angeles • Minneapolis • New York • Philadelphia • Pittsburgh • Providence (R. I.) San Francisco • Seattle • St. Louis • Utica (N. Y.) • Wenatchee • Yakima (Wash.)
In Wisconsin: General Chemical Wisconsin Corporation, Milwaukee, Wis.
In Canada: The Nichols Chemical Company, Limited • Montreal • Toronto • Vancouver

Chicago Expects Return to Normalcy

Local Trade Fearful That Supply May Continue Short—Dr. Kress Talks Before Professional Group — Tablet Manufacturers Hear J. T. Meek Speaks — Wallpaper Group Discuss Strike Threat

CHICAGO, Sept. 24—Paper men greeted rescinding of M-93 with a relief arising from the fact that it was most certainly the beginning of a return to normalcy. However, the relief was quite tempered by the fact that even though mills do not now have to ship on order of the Government, the actual over all supply will remain about unchanged and the immediate effect of the rescinding is more or less debatable.

There is little feeling of a quick betterment within the trade. Those who have mill connections point to the fact that actually what is being used up now is pulp made from wood that has already been cut and that it will be impossible to do any logging this winter to replenish this inventory. Thus, say local paper trade leaders, the combination of seasonal difficulties plus the continued shortage of labor makes any appreciable improvement in the over all position impossible before late next Spring.

Meanwhile, specific market conditions continued little changed. There was some overall improvement noted in the box board industry where reconversion to peace time needs is moving along at a better rate,, according to reports. "Military" papers still felt the tremendous press of Government demand while books and covers in general were still fundamentally unchanged as far as supply and demand conditions are concerned.

Dr. Kress Speaks in Chicago

With the use of a novel and arresting announcement of its meeting, the Chicago Professional Paper Group resumes its meeting program next Monday evening, September 24, with an unusually interesting evening planned. As is customary, the dinner meeting will be held at the Chicago Bar Association and the speaker will be Dr. Otto Kress, Technical Director of the Institute of Paper Chemistry. His subject will be: "Paper Making for the U. S. Armed Forces in Continental Europe in 1945." Dr. Kress, whose reputation in the industry is very favorable and widespread, is the author of more than fifty publications. There are more than thirty United States and Foreign patents bearing his name. His recent experiences in Europe, particularly as they apply to paper and the paper trade, are certain to provide a most interesting and informative talk. It is reported that the Group will make provision for ample questioning following the address itself.

Though the meeting is the first one held since last June, the Group will give the entire evening over to Dr. Kress with the exception of a brief session at which time amendments to the by-laws of the fast growing organization are to be discussed. A special effort is being made to get a large audience for the illustrious speaker and many guests are expected to be on hand. Harry Weston of the Fritz Publications is president of the Group.

Supply Group Meets Here

The Paper Stationery and Tablet Manufacturers Association held its annual meeting conference at the Edgewater Beach Hotel in Chicago on September 20 with more than fifty member manufacturers present from all parts of the country. The sessions were under the direction of Edgar P. Eaton, executive secretary, and were for the most part devoted to a discussion of the supply situation and of post-war conditions.

J. T. Meek, executive secretary of the Illinois Federation of Retail Association, addressed the group on Thursday noon, September 20, on the subject of the post-war position of retail outlets. The speaker stressed the necessity for immediate abandonment of all war time controls and warned against selectivity in choosing to request continuance of controls "which help you a bit" while asking for abandonment of controls "that hurt." He said that our goal of full employment could not be met with controls and warned that their continuation, plus other factors, would force the Government to begin public spending to insure against depression.

The speaker saw the need for "exploding two myths' in the post-war world. One was that profits and the "unit profit" fallacy was too generally accepted. He urged that business and the OPA accept the fact that "it is the total dollar margin that determines not only whether there shall be a profit or loss but also how much the profit or loss may be." He also urged manufacturers to quit "making a fetish out of the possibilities of mass distribution in effecting price reductions" and warned that mass distribution can only come through elimination of personnel and elimination of profits, "two things which I don't believe labor and free enterprise can or will stand." He added that "distribution, giving time and place utility is really the breaking down mass."

Wallpaper Industry Nears Strike

A strike vote is being conducted among 6,000 members of the nations wallpaper manufacturing industry according to announcement made in Chicago by the union attorney. It is alleged that employers have "turned down" wage and other contract demands of the United Wallpaper Craftsmen and Workers' Union. Union demands have been for an average wage increase of 13 cents an hour. Employers, it has been reported here publicly, are offering an average increase of 6 cents an hour which would be contingent on price relief granted the industry by the OPA. The union promptly rejected the offer and started the strike among its members at once.

Goodby To Salvage Program!

Chicago wound up its waste paper salvage campaign in a blaze of glory last week and said good-by to wartime wastepaper salvage by donating thousands of tons in the last curbside collection campaign. Five thousand Boy Scouts, manning 700 trucks contributed by trucking firms, the armed forces and by private owners picked up the bundles of saleable paper. The goal was 6,000,000 pounds—enough to make 3,000,000 heavy supply cartons for shipping goods to troops in the Pacific—was reported as achieved.

EVAPORATORS-CONDENSERS-FILTERS

One frequently neglected source of economy that is particularly adaptable to post-war plant improvement is the use of a surface Condenser on a multiple-effect Evaporator.

The use of a low-cost surface Condenser makes possible the conversion of low temperature heat, usually wasted, to the heating of wash waters.

The services of Goslin-Birmingham's Reconversion Department are available for the study of your individual plant problems. A thoroughly-trained, experienced staff of engineers fully abreast of current conditions and post-war operational methods, stands ready to serve you.

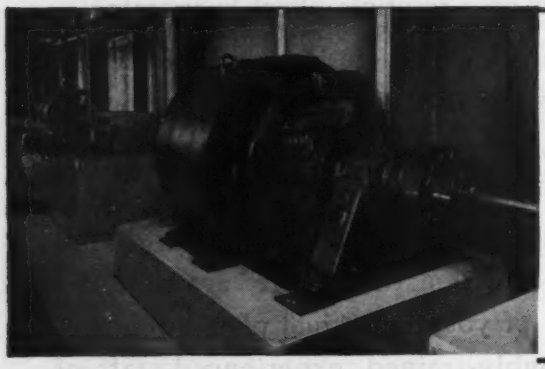
THERE'S A

WESTINGHOUSE DRIVE

FOR EVERY PAPER MACHINE

SECTIONAL DRIVE . . . If you want better paper quality, better operating efficiency, lower operating cost—*increased profit*—then you'll want a Westinghouse Sectional Motor Drive.

This co-ordinated individual motor drive synchronizes the operation of the separate sections into a single continuous process. Westinghouse pioneered in its application to every type and size of paper machine—producing every class of paper from tissue to board.



SINGLE-MOTOR DRIVE . . . To improve paper quality and increase production on your lineshaft-driven machine, get the Westinghouse Single-Motor Drive. No expensive alterations are necessary to existing machines.

The single-motor drive can be belted, geared or direct-coupled to the variable speed lineshaft. Size or type of machine makes no difference; there's a drive to fit *your* requirements. Every Westinghouse Single-Motor Drive is engineered to the job.

TURBINE DRIVE . . . The Westinghouse Adjustable-Speed Turbine for paper machines is ideal to meet certain mill requirements—low first cost—25:1 speed range, if required—constant speed at any speed within this range—high operating efficiency and reliability.

Where engine drives have become inadequate, or where a careful economic study, including heat balance and electric power facilities dictate a steam drive, use this modern turbine drive. Westinghouse Electric Corporation, Dept. 7-N, East Pittsburgh, Pa.

J-94628

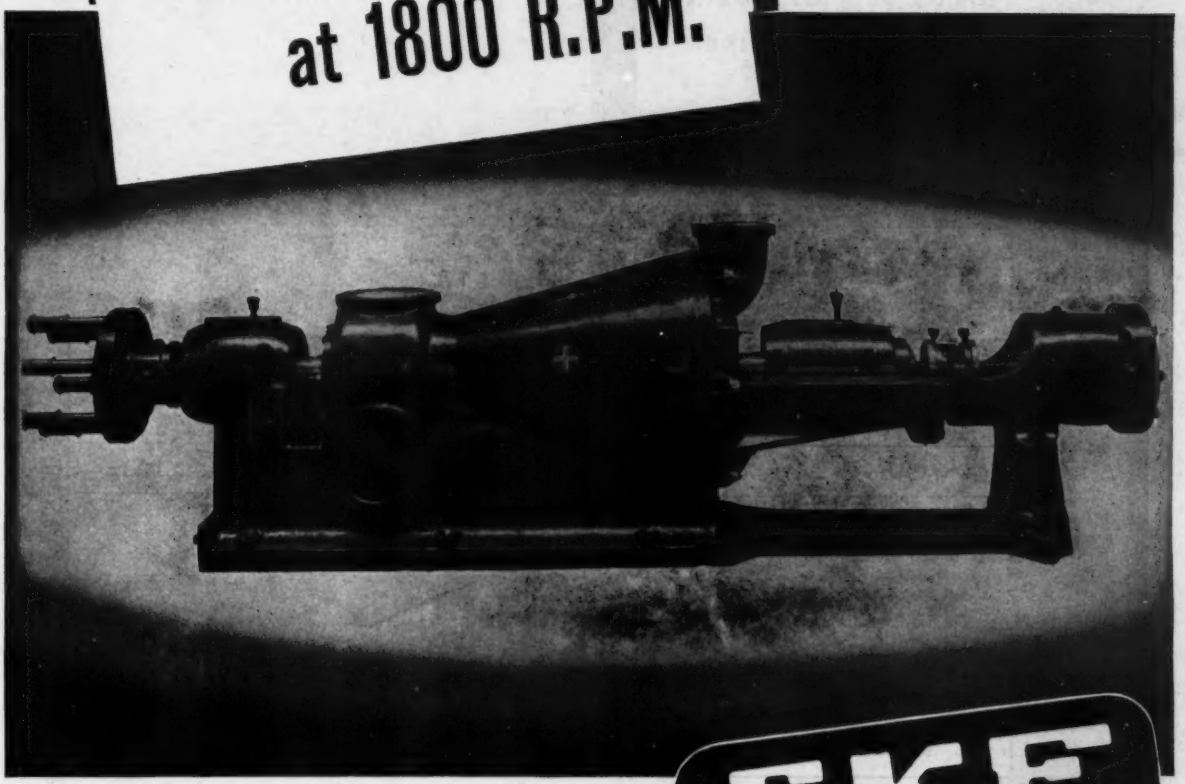
Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

WESTINGHOUSE PRESENTS
. . . JOHN CHARLES THOMAS
SUN. 2:30 EWT., NBC.
"TOP OF THE EVENING"
MON. WED. FRI. 10:15 EWT., BLUE NET.

Paper Machine Drives

Refining 1000 g.p.m. at 1800 R.P.M.



● *Built by* SHARTLE BROS. MACHINE CO., Division of THE BLACK-CLAWSON CO.

When this Hydrafiner refines up to 1000 gallons per minute of paper stock at 6% consistencies at 1800 r.p.m., there's a quick response from SKF Spherical Roller Bearings. For SKF are built to run smoothly and continuously at high speeds . . . to maintain plug setting . . . to require only occasional lubrication in years of faithful performance. That's why, in the manufacture of paper, the number of SKF-equipped machines is steadily increasing.

5866

SKF INDUSTRIES, INC., PHILA. 34, PA.

SKF
BALL AND ROLLER BEARINGS

doubleproof

MERSIZE SAVES UP TO 50% OF ROSIN ORDINARILY REQUIRED

Here are actual figures showing how two different mills adapted Mersize to their sizing operations . . . and reduced the rosin requirement:

1

SIZING DATA
(Per ton of paper — 100% rag content)

	FORMER METHOD	MERSIZE METHOD
Rosin	25 lbs.	8.5 lbs.
Mersize	0 lbs.	6 lbs.
Pen and Ink Feathering Test: Same in both cases.		

2

SIZING DATA
(2,000 lbs. of 100% sulfite)

BEFORE ROSIN ALLOCATION	AFTER ROSIN ALLOCATION	MERSIZE METHOD
Rosin . . . 28.9 lbs.	24 lbs.	12 lbs.
Wax . . . 0 lbs.	6 lbs.	0 lbs.
Mersize . . 0 lbs.	0 lbs.	6 lbs.
Ink penetration in minutes	24 min.	25 min.

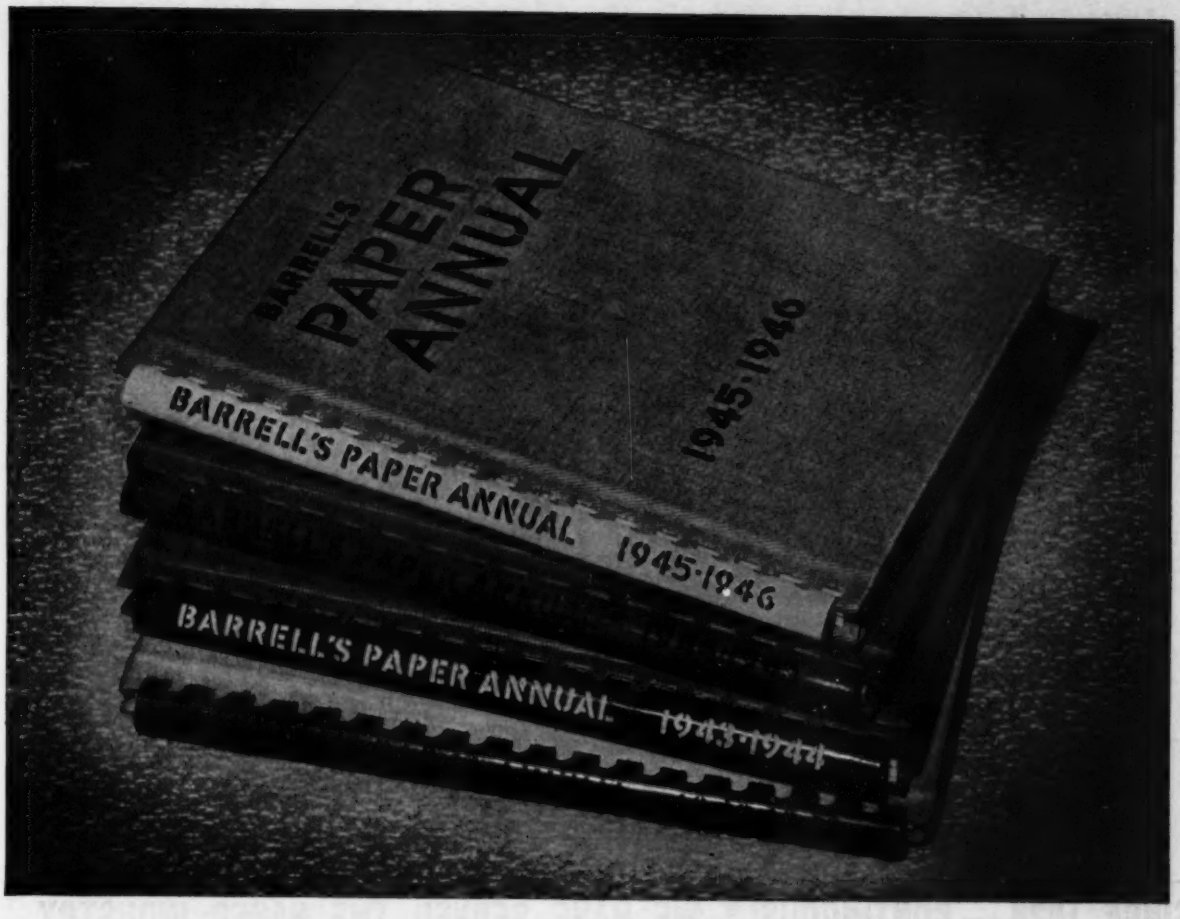
A trial in your mill will demonstrate to you the savings involved by using this modern paper sizing chemical.

Mersize* contains no wax and eliminates the necessity of using wax, which materially reduces paper strength and quality. Mersize is supplied as a paste and is readily dispersible with mechanical agitation in water or in the dilute resin emulsion.

For complete Mersize data and information about a trial in your mill, address: MONSANTO CHEMICAL COMPANY, Merrimac Division, Everett Station, Boston 49, Massachusetts.

*Reg. U. S. Pat. Off.

MONSANTO CHEMICALS
SERVING INDUSTRY...WHICH SERVES MANKIND



Definitely a Perennial

Containing the only illustrated Directory of Paper Industry Associations. If your file is not complete let us know what volume is missing. We will try to replace it.

'SIAMESE TOUR BOSS'

WILLIAM L. BARRELL COMPANY
LAWRENCE, MASSACHUSETTS

Velvet Tissue Starts $200,000 Program

FULTON, N. Y., September 22, 1945—An expenditure of approximately $200,000 will be made in the enlargement and improvement of the Velvet Tissue Company, Inc., Richard F. Baker, president, announced Monday afternoon. Baker said construction work already had started. The project is expected to be completed between Nov. 15 and 20, with Baker stating the addition and purchase of new equipment would permit the plant to boost production of facial tissues 75 per cent.

Included in the remodeling is a story and a half brick building, adjoining the plant machine room and previously used for storage. The roof of the old building has been ripped away and a portion of the walls torn down, with a new roof and walls to be built. A complete new floor also will be laid. An addition of 100 feet by 40 feet is being built.

Baker said the new and improved structure would house the converting room. He announced a new automatic machine had been purchased and would be placed in the room. The machine, Baker said, will automatically count, fold and pack the tissues. Baker also announced a new paper making machine had been secured and would be installed in the old converting room. Work on the improvement and addition started three weeks ago, Baker said.

Mohlman Active in War Chest Drive

SPRINGFIELD, Mass., September 22—George A. Mohlman, president of Package Machinery Corporation, heads the public and information and education division of the Springfield War Chest drive.

New Wet-Strength Paper Available

For the first time, large tonnage of "Wet Strength Map" paper, evolved in a revoluntionary new process discovered during the war, is being offered to the trade nationally. This new, extra strong paper will make its civilian appearance in September as part of the $200,000,000 overall surplus property disposal program announced by the Department of Commerce, Office of Surplus Property.

It is made from Bleached Sulphate to rigid Army specifications, and is hard sized by a method that causes the paper to retain 40% to 50% of its dry strength after it has been thoroughly saturated. The color is a good white and the finish is smooth.

This paper is available in 22 x 29, and 35 x 45 sizes, substance 24/500—250 lbs. to a case, and is packed in water-proofed lined cases originally intended for overseas shipment.

Sales of Wet Strength Map paper will be made directly to the trade through regional offices of the Department of Commerce, Office of Surplus Property. Orders will be accepted at any regional office for a period of 15 days following the date of the sale announcements issued to the trade from the regional offices.

Regional offices of the Office of Surplus Property are located at 600 Washington street, Boston, Mass.; Sixty-First Floor, Empire State Bldg., New York, N. Y.; Lafayette Bldg., Fifth and Chestnut streets, Philadelphia, Pa.; 704 Race street, Cincinnati, Ohio; 209 South LaSalle street, Chicago, Ill.; 105 Pryor street, N. E., Atlanta, Georgia; 609 Neil P. Anderson building, Fort Worth, Texas; 30 Van Ness avenue, San Francisco, Cal.; 2005 Fifth avenue, Seattle, Wash.

SINCE 1828 — CONTINUOUSLY WE HAVE SERVED THE PAPER INDUSTRY.

The war is not over. But when it is over, will you be among the first to receive new equipment?

We can now book approved orders which will be filled in the order received.

Some will have to wait—so plan now to be the first.

Paper Bag Machines

Paper Machines **Jordans**

Paper Trimmers—new model E.

THE SMITH & WINCHESTER

MANUFACTURING COMPANY

PLANT AND OFFICES AT SOUTH WINDHAM, CONNECTICUT

ONE OF 27 DOW CHEMICALS USED BY THE PAPER INDUSTRY

they put it in writing!

pencil makers pick Methocel as thickener and binder

Methocel has a knack for pointing out easier ways to do things. Example? Ask the pencil manufacturers! Here's how Methocel helped them simplify the preparation of colored crayon pencil leads:

Into these leads must go a wax, a water-soluble pigment, a thickener, and a binder. Alert manufacturers consulted with Dow . . . found that Methocel could take over both the thickening and binding roles—and do them well. Moreover, Methocel would not decompose, eliminating any necessity for adding a preservative.

Today Methocel is the most widely used colored crayon thickener and binder. The wax and coloring matter are simply incorporated into a thick Methocel solution or paste, and leads of smooth, even quality result.

What jobs can *you* do more efficiently with Methocel? As a dispersing medium, thickener, binder, and coating agent, this water-soluble cellulose ether is solving many problems. For full particulars about Methocel, just drop a line to Dow.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit • Chicago
St. Louis • Houston • San Francisco • Los Angeles • Seattle

Methocel

Water Soluble Dow Methylcellulose

DOW

CHEMICALS INDISPENSABLE TO INDUSTRY

Pacific Mills Studies Veteran Plan

VANCOUVER, B. C., September 25, 1945—Representatives of management and labor in the organization of the Pacific Mills have been drawn together in a joint committee for the purpose of aiding in the rehabilitation of employees of the company returning from active service. The establishment of this committee is the key feature of a reinstatement and rehabilitation plan, the details of which have now been released by Pacific Mills Limited of Vancouver, B. C., and Ocean Falls, B. C. The plan will also include employees of Canadian Boxes Limited and the Hudson Paper Company Limited.

This committee interviews each veteran on return, and after careful consideration of previous experience, experience gained overseas, acquired ability to accept responsibility, and his own desires, makes recommendation to the personnel supervisor.

Responsibility of committee will not cease at reinstatement. Progress on the job is followed at definite intervals with a report to the rehabilitation committee. Where changes are necessary to assist in normal readjustment, the committee is empowered to make recommendations.

The company will do everything in its power to provide work for its disabled veterans. A survey of jobs will determine those which can be performed by, or adapted to a disabled worker.

The plan has co-operation of the two employee unions. Both have agreed that in case of returning veterans, regulations will be interpreted liberally so that men can get back on the job with the minimum of delay or difficulty.

Mosinee Reelects Officers

APPLETON, Wis., September 17, 1945—Officers and directors were reelected at the annual meeting at Wausau, Wis., last week: A. P. Woodson, president; Mr. Stone, vice president and general manager; George L. Ruder, vice president; J. D. Mylrea, treasurer; H. L. Dessert, Mosinee, secretary; William Knoedler, Mosinee, assistant secretary-treasurer.

Directors: Messrs. Woodson, Ruder, Stone, Dessert, Mylrea, H. M. Thompson, Milwaukee and J. R. Diggs, Chicago.

Gross sales for the year ending May 31 showed a substantial increase and shipments exceeded those of the previous year. Full production was maintained but profits were less, due to increased timber and operational costs.

W. J. Servotte, Green Bay, vice president and general manager of the firm's Bay West towel division in Green Bay, gave a report concerning that division, and Mr. Mylrea, who is in charge of timber operations, made a report on these activities.

Stevens Mills Insures Employees

ROCKVILLE, Conn., Sept. 15, 1945—Employes of Hockanum mills of the M. T. Stevens & Company, employed on an hourly paid or piece work basis, will soon be covered by life insurance, accidental death insurance, sickness and accident benefits, surgical expense benefits and hospitalization benefits. The insurance is effective as of the 15th, except Blue Cross hospitalization plan, which is effective October 1.

With VORTRAPS INSTALLED

WON'T GET YOU DOWN

Over 300 pulp and paper mills have over 2000 Vortraps working continuously—24 hours a day—removing objectionable material from their stock. For, today stock is dirtier than ever.

Vortrap equipped mills not only find Vortraps a simple, effective and economical means of removing objectionable dirt but a worthwhile means of substantially lengthening the useful life of wires and felts.

Vortraps have no moving parts, use little power, require practically no labor to operate and occupy little space.

NICHOLS

ENGINEERING & NERCO RESEARCH CORP.

60 WALL TOWER
NEW YORK 5, N. Y.

UNIVERSITY TOWER BLDG.
MONTREAL, P. Q.

Farval for Reconversion

Advantages of the centralized lubricating system when installing machine equipment for post-war operations are pointed out in an illustrated four-page folder, "When you Reconvert", issued by The Farvel Corp., Cleveland, O. Basic facts are set forth in a compact summary showing how the Farval system operates.

As an example the folder points out that one oiler per shift formerly was required to lubricate a large machine. Installation of the Farval System not only released the three for other work, but in addition reduced oil consumption from 6 gallons to 1 pint per day.

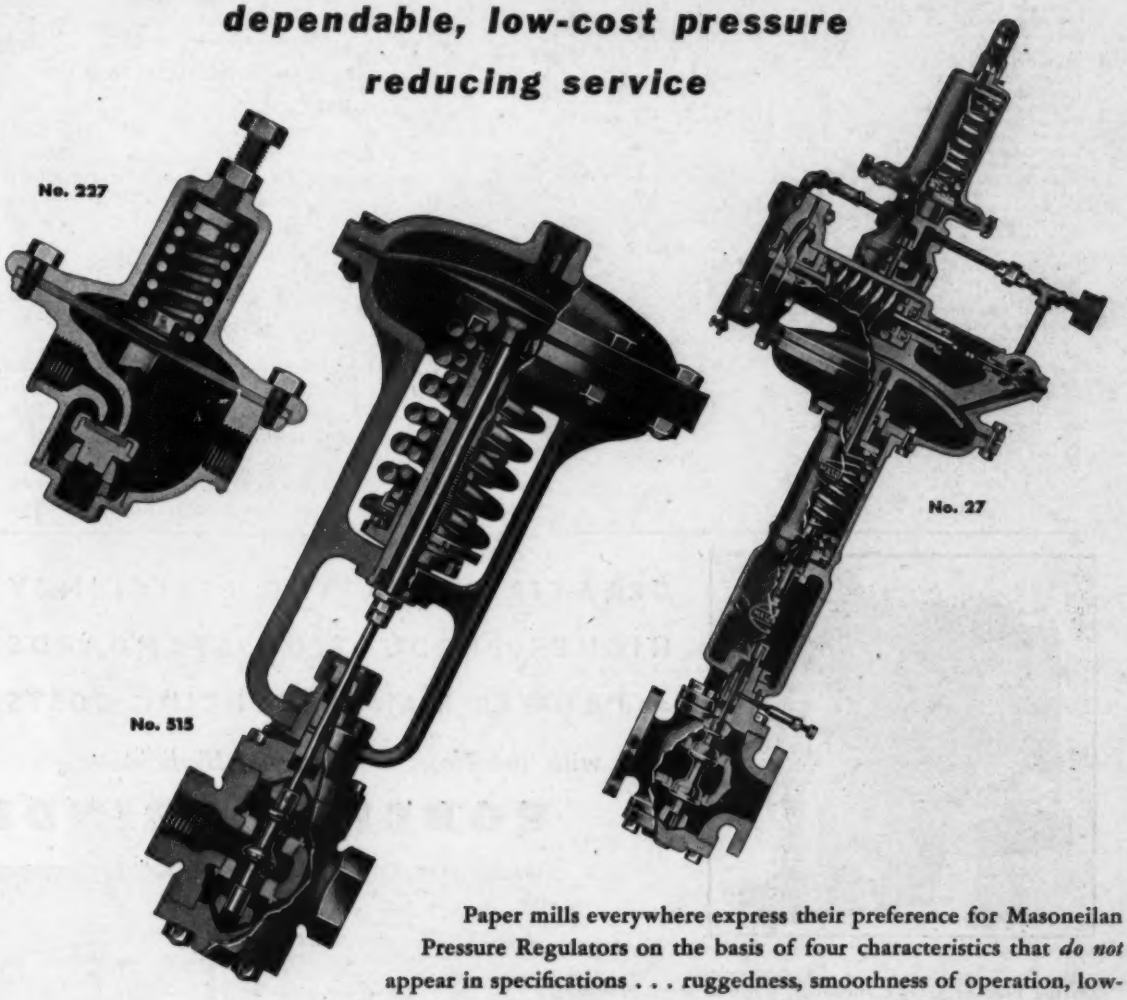
The system delivers measured amounts of oil or grease from a central supply unit to the farthest bearing surfaces, at any predetermined interval. It consists of a central pumping unit, two main supply lines and a measuring valve for each bearing.

The complete range of Farval Systems, including both manual and automatic types for a wide variety of industrial equipment, are illustrated. A copy of the folder may be obtained by addressing The Farval Corp., 3249 East 80th Street, Cleveland 4, Ohio.

MASONEILAN

PRESSURE REGULATORS

Speed up paper production with accurate, dependable, low-cost pressure reducing service



Paper mills everywhere express their preference for Masoneilan Pressure Regulators on the basis of four characteristics that *do not* appear in specifications . . . ruggedness, smoothness of operation, low-maintenance and low-operating costs. No matter what your pressure reducing service requirements . . . steam, water or air . . . you too, can save money by installing Masoneilan Regulators. Their accurate operation, ease of adjustment, and long-lived performance will reduce waste and minimize production delays due to time out for servicing . . . Investigate Masoneilan Pressure Regulators. Write for Catalogs 72 and 73, today.

MASON-NEILAN REGULATOR CO.
1181 ADAMS STREET, BOSTON 24, MASS., U. S. A.

MASONEILAN

New York, Philadelphia, Pittsburgh, Cleveland, Chicago, Tulsa, Atlanta, St. Louis, Houston, Los Angeles, San Francisco. Mason Regulator Co. of Canada, Ltd., Montreal, Canada

FINANCIAL NEWS

New York Stock Exchange

High, Low and Last for Week Ending September 22, 1945

STOCKS

	High	Low	Last
A. P. W.	7⅜	6⅜	7⅜
Armstrong Cork Co.	55½	52½	54
Celotex Corp.	19⅜	17¼	19⅜
Celotex Corp., pf.	21⅞	20⅜	21¼
Certain-Teed Products Corp.	15⅞	13¼	15⅝
Certain-Teed Products Corp., pf.	175	165¼	170½
Champion Paper & Fibre Co.	42¼	39	41¾
Champion Paper & Fibre Co., pf.	...	...	...
Congoleum Nairn Co.	36½	33	35¾
Container Corp. of America	33¼	31⅜	32½
Continental-Diamond Fibre Co.	13⅞	13	13½
Crown-Zellerbach Co.	26¼	25	25¾
Crown-Zellerbach Co., pf.	103⅝	103	103⅜
Dixie Cup Co.	34½	32	34½
Dixie Cup Co.,—A	48	47⅜	47⅜
Flintkote Co.	33½	30⅜	32⅛
Flintkote Co., pf.	108½	108½	108½
Robert Gair	8	7	7⅞
Robert Gair, pf.	18¾	18⅜	18⅜
International Paper Co.	33⅜	29¾	33
International Paper Co., pf.	100⅞	99½	100⅞
Johns-Manville Corp.	143	131	139½
Johns-Manville Corp., pf.	133	130½	132½
Kimberly-Clark Corp.	52⅜	51½	52⅜
Mac Andrews & Forbes	34½	34	34⅜
Mac Andrews & Forbes, pf.	...	...	...
Masonite Corp.	48½	45½	48⅛
Mead Corp.	18⅜	17⅜	18⅛
Mead Corp., pf. A—6%	...	...	...
Mead Corp., pf. B—5%	103½	103½	103½
National Container Corp.	18¾	16⅜	18⅜
Paraffine Companies, Inc.	73	73	73
Paraffine Companies, Inc., pf.	107¾	107¾	107¾
Rayonier, Inc.	22¼	20	22
Rayonier, Inc., pf.	37⅛	36½	36¾
Ruberoid Co.	42½	41	42½
Scott Paper Co.	55½	55	55
Scott Paper Co., pf.	111	111	111
Sutherland Paper Co.	37	36½	37
Union Bag & Paper Corp.	21⅛	19¼	20¾
United Paperboard Co.	8¼	7¾	7⅞
U. S. Gypsum Co.	102¾	100	100
U. S. Gypsum Co., pf.	...	...	...
West Virginia Pulp & Paper Co.	32⅝	30¼	32⅜
West Virginia Pulp & Paper Co., pf.	110⅛	110⅛	110⅛

BONDS

Abitibi Pulp & Paper Co. 5s '53	105⅜	102¾	105⅜
Celotex Corp. 3¾s '55	...	...	...
Certain-Teed Products Corp. 5½s '48	...	...	...
Champion Paper & Fibre Co. 4¾s '50	...	...	...
International Paper Co. 6s '55	108½	108	108⅛
International Paper Co. 5s '47	104	104	104
Mead Corp. 3½s '53	...	...	...

New York Curb Exchange

High, Low and Last for Week Ending September 22, 1945

STOCKS

	High	Low	Last
Great Northern Paper Co.	38½	37⅞	38⅛
Hummel-Ross Fibre Corp.	10¾	9⅞	10½
St. Regis Paper Co.	8	7⅛	7⅞
St. Regis Paper Co., pf.	...	...	...
Taggart Corp.	7	6½	6⅞

BONDS

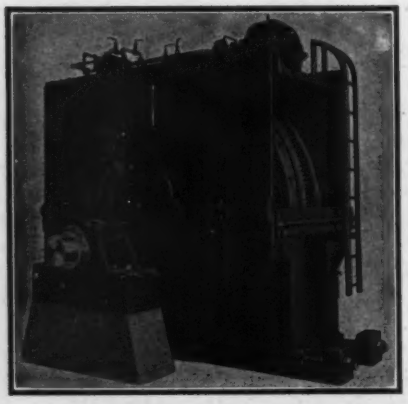
American Writing Paper Co. 6s '61	...	...	...

Casein Production Up in July

WASHINGTON, September 25, 1945—A 3-per cent gain in dry casein production during July, compared with that of the same month last year, was announced by the Department of Agriculture in reporting last week that the output amounted to 1,740,000 pounds, this July.

This is the second time this year that present production has exceeded the output of the previous year. On July 31, domestic producers held an estimated 6,510,000 pounds of dry casein, 4 per cent less than on the same date last year. However, reports now indicate domestic supplies will be supplemented by arrival of two boats with approximately 1,400 tons of casein from the Argentine during September.

The Argentine market was stronger, as a result of increased European purchasing and prices f.o.b. Buenos Aires ranged from 16½-17½ cents per pound, and by September 1 were up to 18 cents.

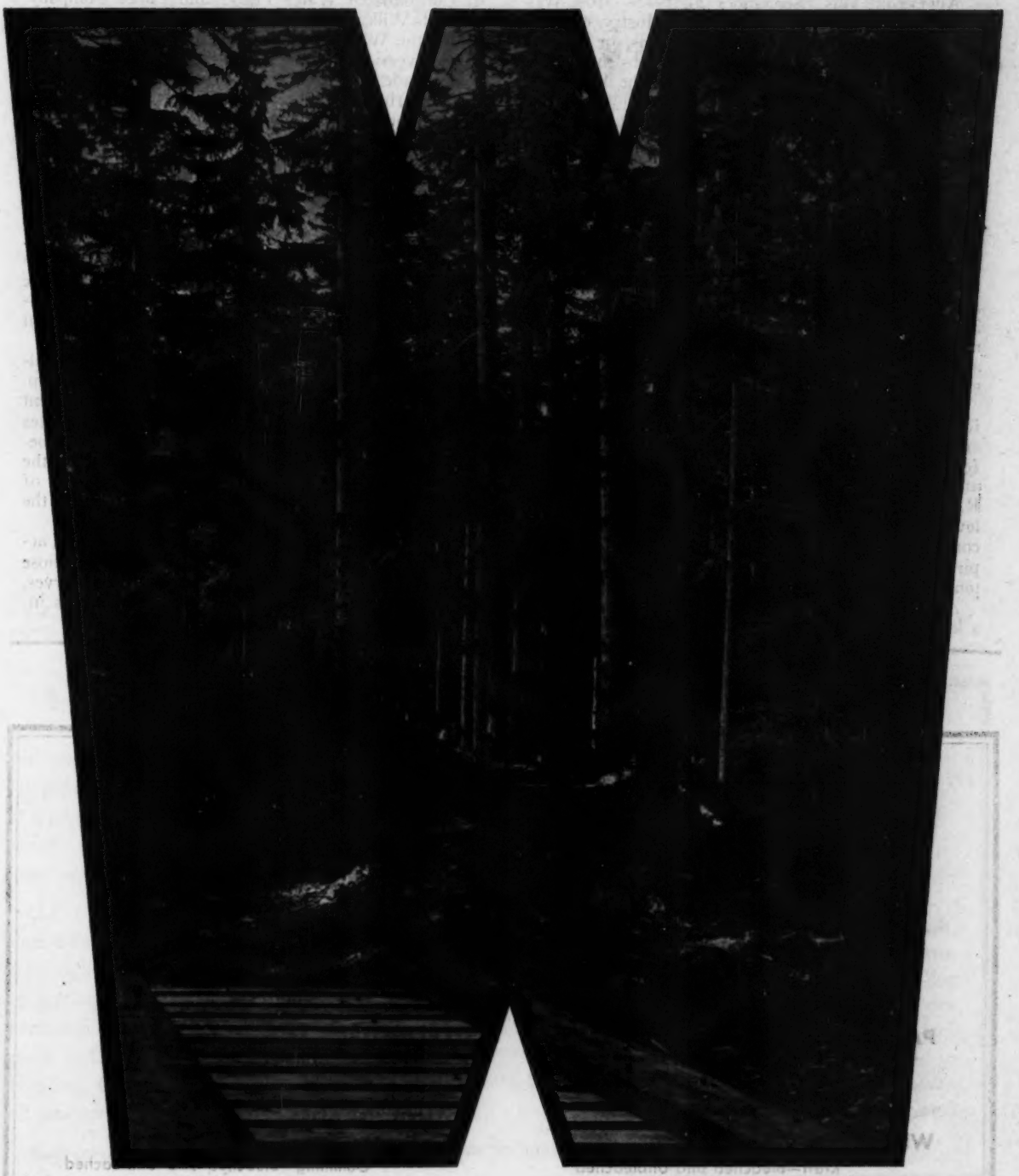


GREATER OPERATING EFFICIENCY
HIGHER PRODUCTION STANDARDS
and LOWER MANUFACTURING COSTS
with the New, Continuous, High-Speed
ROBERTS GRINDER

During the war years a thorough study of the performance of the Roberts Grinder was carried on. The soundness of the operating principle has been definitely established. It has been demonstrated that continuous, high-speed grinding is a much faster and a more profitable way to manufacture groundwood pulp. Cost per ton of pulp is reduced. Better grades of stock are produced at any freeness and uniform consistency is maintained. Working conditions are improved with cleaner and safer operation. Now many engineering refinements are being added in the post-war Roberts Grinder.

THE APPLETON MACHINE COMPANY
APPLETON • WISCONSIN • Eastern Sales Representatives, CASTLE & OVERTON, Inc., 630 Fifth Avenue, New York

WEST COAST HEMLOCK PULP



HARVESTING of mature virgin timber for lumber and Weyerhaeuser bleached sulphite pulp requires the planned projection of new track for the logging railroad.

PULP DIVISION ‡ WEYERHAEUSER TIMBER COMPANY

Wisconsin's Reconversion A Minor Problem

APPLETON, Wis., September 24, 1945—Most Wisconsin cities in which the paper industry operates have only minor reconversion problems, or none at all. As a general rule, there are more jobs than workers in virtually all industrial cities in the Wisconsin and Fox river valleys.

In many such cities the industry is providing extensive additional employment through the start of expansion programs, most of them planned before the war but of necessity postponed until the postwar era.

At Wisconsin Rapids and the nearby communities of Nekoosa, Port Edwards and Biron, where the paper industry predominates, there has been no "war boom," even though the industry has made significant contributions toward victory. Wholesome strides have been made in the growth of population and economic contributions. The Consolidated Water Power and Paper Company already has launched big expansion projects.

Ahdawagam Paper Products Company, Wisconsin Rapids, whose shipments of 11,000 tons in 1940 increased to 17,000 in 1944, the latter being primarily for military requirements, had about 100 employes at the start of the war, and came out with 150. Frank R. Walsh, president, expects the postwar employment level to be from 160 to 170. During the war this company's four main products were solid fiber shipping containers, corrugated containers, folded cartons and paper tubes.

At Stevens Point, Wis., work has been started on a large addition to the Wisconsin River division mill of Consolidated Water Power and Paper Company.

D. B. Wilkinson of the Marinette Paper Company, Marinette, Wis., reported there is no serious problem in reconversion. There has been a cutback on tissues being made for K-ration boxes, but employes have been absorbed into other departments of the mill.

An improvement program which will extend over several years has been started at the Mosinee Paper Mills Company, Mosinee, Wis.

Such giants of the industry as Kimberly-Clark Corporation and Marathon Corporation have advertised extensively for employes and are still doing so, as are other mills in the Fox and Wisconsin valleys.

A new boiler which will increase the power capacity of Marathon Corporation of Menasha by more than 50 per cent and will take care of future expansion as well as present needs is being installed at Menasha, Wis.

The boiler, worth about $75,000 and weighing almost 31 tons, arrived last week from New Ulm, Minn., on a special flat car, coming via four different railroad lines, and was routed through four states and 400 more miles further than the direct route because of the necessity to obtain clearance for the 4-drum water tube boiler. The flat car is one of four in the United States. Its total weight when the boiler was on the car was about 120 tons.

The boiler traveled on special trains all the way, accompanied by an additional pilot on each train whose job it was to check clearances, bridges and curves. The boiler traveled only during the day and was inspected 20 times while en route.

TRADE MARK

Trinity Bag & Paper Co., Inc.

25 WEST 43rd STREET • NEW YORK 18, N. Y.

Mill Agents and Distributors

PAPER BAGS AND SACKS
All Types and Styles
Self-Opening, Square
Flat and Sacks

WRAPPING PAPERS
Kraft—Bleached and Unbleached
Butchers—Dry and Water Finish
M. G. Papers—Bleached and Unbleached

WRITINGS
Bonds and Ledgers
Index

OTHER GRADES
Envelope, Offset and Printing
Gumming—Bleached and Unbleached
Kraft Specialties of all Descriptions — both Bleached and Unbleached

Agents for:

FLORIDA PULP & PAPER CO., PENSACOLA, FLA. • SANTA ROSA PULP & PAPER CO., PENSACOLA, FLA.

BAG PLANTS AT MOBILE, ALABAMA, AND MONROE, LA.

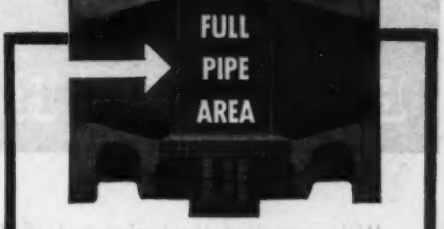
Why handicap your Pipe Lines with Restricted Area Valves?

a.C.f.

Lubricated Plug Valves give

FULL PIPE AREA = FULL FLOW

Typical installation of a.C.f. Lubricated Plug Valves.



SOLVES LADING PROBLEMS

Tar, sludge, grouting, asphalt, viscose, rayon, nylon, granular solids, paints and similar viscous or waste materials are all handled efficiently—as are paper pulp, pulp while in process, black liquor, white liquor, caustics, acids. Send for Catalog No. 3-T.

If difficult ladings are choking your pipe lines, a change to a.C.f. Lubricated Plug Valves can work wonders. How? Because the cylindrical plug provides a well-proportioned, round-cornered, *full* pipe-area port opening for unrestricted flow and full pressure of fluids. There is no change of flow direction, turbulence is overcome — and since flow velocities are not increased (abrasion being reduced) valve life is extended.

a.C.f. Lubricated Plug Valves operate easily and at a quarter turn. Balancing of lubricant pressures against line pressure makes them tight against head leaks. Even in the open position they have no seating surfaces exposed to lading wear and the lubricant keeps corrosion at a minimum. Compact, and with the fewest possible parts, a.C.f. Lubricated Plug Valves may be installed in any position. a.C.f. Lubricated Plug Valves will efficiently handle all processing and industrial plant ladings.

Representatives in principal cities carry adequate warehouse stock for quick delivery.

AMERICAN CAR AND FOUNDRY COMPANY

Valve Department
30 Church Street, New York 8, N. Y.

Sorg Officers Visit Canada

VANCOUVER, B. C., September 22, 1945—J. A. Aull, President of the Sorg Pulp Company, and D. G. Driscoll, President of the Sorg Paper Company of Middletown, Ohio, together with H. C. Lange and L. C. Courier, directors of the two companies, recently arrived in Vancouver on an inspection visit to the head office and Port Mellon, B. C., plant of the Sorg Pulp Company Limited. Dr. Otto Kress of the Institute of Paper Chemistry, Appleton, Wisconsin, accompanied the party in a consultnig capacity.

Pittsburgh Glass Appoints Simpson

W. I. Galliher, executive sales manager of Pittsburgh Plate Glass Company, Columbia Chemical Division, announces the appointment of R. M. Simpson as sales representative for the Chicago territory. Mr. Simpson will be located in the Chicago Office at 1721 Tribune Tower Building, and will represent the company on the sale of alkalies, liquid chlorine, and related industrial chemicals. He began with Pittsburgh Plate in September, 1944.

Resin-Bond Paper Expected Soon

HOLYOKE, Mass., Sept. 15, 1945—Resin-bonded paper will soon appear in many peacetime products, local paper manufacturers said today. This paper was used during the war to make military maps that would withstand tough handling. Now it will go into towels, wrappings, bags, posters, shipping tags, photographic paper, garbage containers and disposable diapers. The resins used are synthetic.

We're proud of the background of the W. G. P. organization which started over 85 years ago. None of the founders are among us today, but all of us here at W. G. P. have been in the paper business for many years. For example: The three principals have collectively been connected with this firm for over a century. This long experience and service is undoubtedly responsible for the confidence and the continued good will that W. G. P. enjoys today. W. G. P. is vitally interested in making additional mill connections—both for the present and the future. If any part of your output is available for the domestic or export field, write us at once.

PAPERS
Printing, Converting, Industrial
TISSUE AND BOARD — SPIRAL MILL CORES — MILL SUPPLIES
LAMP SHADE SPECIALISTS
Saturating Papers for Plastics and Natural or Synthetic Rubber
Eastern Representatives for E. J. Cady Paper Scales and Micrometers
Agents for Ames Pocket Micrometers

When More Paper and Board Is Available Depend Upon Us to Supply Our Share

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448-450 PEARL ST., NEW YORK 7, N.Y. • WORTH 2-0050
EXPORTS TO ALL PARTS OF THE WORLD
PAPER AND BOARD

Moniteau Opens Lab

CALIFORNIA, Mo., September 20, 1945—A quality control testing and research laboratory will be ready for operation on November 1, 1945 at the plant of Moniteau Mills, Incorporated. The laboratory will be equipped and staffed by the United States Testing Company, Incorporated, and will conduct necessary tests to accurately control the quality of the materials through all stages of manufacture.

This trend, on the part of manufacturers to better serve quality minded consumers, has been brought about by many reasons but probably the two greatest causes are the consumer movements now operating to force proper labeling and the aftermath of producing on specification for the Government.

Perkins Plans Addition

HOLYOKE, Mass., Sept. 15—The B. F. Perkins & Son, Inc., manufacturers of paper making machinery, has a major postwar expansion program in the works that will require a 50,000-square foot mill addition to its plant in Willimansett. J. Lewis Perkins, president of the company, said today that he is not yet at liberty to reveal the product which may be made there. However, he said that it concerns an affiliation with a large American industrial corporation. The Perkins plant is now advertising for machine designers and engineers to participate in this new work.

Hendrick Names Warner

Trowbridge A. Warner has been appointed sales manager of Hendrick Manufacturing Company of Carbondale, Pa., effective October 1, the company has announced.

Mr. Warner was formerly sales manager of the Register and Grille Manufacturing Company, Brooklyn, N. Y., and before that held a similar post with Tuttle & Bailey Manufacturing Company.

Craftsmen in rubber

TABLE ROLLS
WIRE ROLLS
FELT ROLLS
COUCH ROLLS
PRESS ROLLS
LUMPBREAKER ROLLS
SIZE PRESS ROLLS
STONITE*

*(Ebonite and Granulated Stone Composite
U. S. Patent 1,787,890 Re. 18,111)

RUBBER COVERED ROLLS

FOR EVERY PAPERMAKING REQUIREMENT

STOWE-WOODWARD, INC.

NEWTON UPPER FALLS 64, MASSACHUSETTS

NEW YORK OFFICE, WOOLWORTH BLDG., NEW YORK 7

STOWE-WOODWARD ROLLS ARE MADE ON THE WEST COAST BY HUNTINGTON RUBBER MILLS, INC., SEATTLE 4, WASHINGTON

Panel Denies Differential

HOLYOKE, Mass., September 15, 1945 — Recommendations of the panel of the War Labor Board, published today, indicate that the government agency did not favor the shift differential of four and six cents an hour for the second and third shift as well as several other demands of the Holyoke Paper Mill and Eagle Lodge of Papermakers unions. The recommendations will be addressed to the regional War Labor Board and if either or both parties to the contract are disinclined to accept the ultimate finding, there is an appeal to the National War Labor Board. Both parties to the controversy may file arguments to be submitted to the regional board with the recommendations of the panel.

The latest development follows the submission in early summer of contested issues on the annual working agreement between the six Holyoke paper manufacturers and the two local unions involved.

In another disputed issue, the panel recommended that the companies be required to pay for three of the six holidays, not worked but claimed by the unions.

In the union claim for time and a half for the sixth day, the panel recommends that determination of the appropriate sixth day be guided as follows: Illness of injury in the plant duty duly certified by the first aid department; instances where a worker reports with reasonable expectancy of work and is sent home for lack of it; union business connected with the plant when properly certified by a responsible union official; death (wife, husband, children and parents) in the immediate family; jury duty and at government agencies.

The panel denied the demand of the companies that the present double time for Sundays and holidays be reduced to time and a half. Also denied was the companies' request that beginners be paid 10 per cent less than the regular rate for the job, and the request that there be inserted a clause prohibiting any rules being made by either party which would nullify the contract.

The companies were supported in their contention that the union system of fines and the union refusal to accept dues from a member who refuses to pay a fine, alters the meaning of the maintenance of membership clause, requiring the company to discharge such an employe. The management said that this request was an attempt to require them to control and regulate the internal business of the unions.

This laugh's on you—and worth it!

SOMEWHERE in the South Pacific, American boys are getting a laugh. A much-needed laugh that helps their morale. A laugh your money helps to buy—when you give to your Community War Fund.

For part of every dollar you give goes to the U.S.O. and helps send the U.S.O. camp shows overseas. And, with the millions of men now idle in occupied territories, the need to keep up their morale is greater than ever. That's why the army has asked the U.S.O. to quadruple its activities. And why your money is needed to help bring to some lonely G.I. a touch of home—the familiar face of Joe E. Brown—the friendly voice of Frances Langford—the dancing feet of Fred Astaire.

Another part of your money is spent right here at home, to help servicemen's families keep living decently, united in happiness and health. Still another part helps cheer our merchant seamen in distant ports of the world. And it helps relieve hunger and sickness and suffering among our fighting allies.

This is a great united cause. And because the needs are so many and so great, give generously—give more than you gave last year. Make your gift as big as your heart.

Give generously to

Your Community War Fund

Representing the NATIONAL WAR FUND

Sullivan Joins Oxford

The Oxford Paper Co. has named Edward J. Sullivan to its New York sales organization. He has been with Fraser Industries, Inc., for the past ten years.

Mr. Sullivan has had extensive experience in the sale of various grades of paper to converting and printing plants and enjoys a wide acquaintance among merchants, converters and publishers.

Union Bag Is Ready

SAVANNAH, Ga., Sept. 12—Officials of the Union Bag and Paper Corporation evinced keen interest this week over announcement that the control over delivery and use of wood pulp will be removed September 30.

"While Union Bag and Paper Corporation has been operating at capacity on war orders," an informed source here commented, "the relaxed control probably will enable us to concentrate on paper for peace."

Ontario Sees Every Prospect Bright

Expected Increase In Available Woodlands and Mill Labor Supply Brightens Outlook For Increased Pulp and Paper Production To Meet Demands That Still Remain Unfilled — Other Late News.

TORONTO, Ont., September 22—With Canadian soldiers returning to their native land at the rate of more than 20,000 a month, employment prospects are brighter for the pulp and paper industry and with the demand for all the products of the industry still on a high level and prospects for the continuation of this happy state for as far ahead as anyone seems willing to forecast, everyone should be happy.

Pulpwood production, the major governing factor in the industry just now, is expected to show steady improvement. The wood cutting season in this district is just ahead; it is expected that the industry should be able at least to recruit as many workers as it did last winter, and the prospects seem to indicate a greater number will be available. Men for the woods are largely recruited from the farms and while there are not likely to be more farmers available for the woods this year, it is expected that at least some of those formerly engaged in the pulp and paper industry and more recently in munitions plants and the armed services, will return again to the woods and mills. The fly in the ointment there is that wages in the pulp and paper industry are not on the same level as industrial workers enjoy and some men may quite naturally wish to remain in the larger centers as long as there is any prospect of them obtaining steady work at the better wages. There is no certainty concerning the position of prisoners of war who have been employed in the woods and mills. Some may be available for the coming winter and again they may not be.

The early break-up last spring left considerable wood just where it was stacked and this will be added to the coming season's cut and brought out next spring. It should boost the total supply considerably.

Fine Papers Still Limited

Fine paper production prospects in Canada remain good and should improve in the near future as more manpower becomes available. White paper has enjoyed a high priority rating throughout the war years and has been favored in the matter of pulpwood and manpower. Previous to the war, considerable quantities of fine papers were imported, but with the Scandinavian countries out of the picture as pulp exporters, a very acute pulp shortage developed in the United Kingdom and other overseas countries as well as in the United States, while the need for white paper has increased during the war. This placed Canada in an export position as she was called upon to supply the essential needs of the Allied powers—New Zealand, Australia, Ceylon, Rhodesia, Middle East Command and elsewhere. Prospects are not bright for very much pulp from Norway, Finland or Sweden for some time because of the fuel shortages in those countries.

Canadian white paper users have been unable to receive any benefit from increased Canadian fine paper production this year, consequently demand is still well in excess of supply. Restrictions on the production and use of white paper still stand and no one looks for anything better than a gradual easing in the future.

It would appear that there will be an all-out production level for Canadian white paper for at least another year with fixed ceiling prices remaining. Costs have crept up as well as taxation so that profits have been squeezed considerably and any relief will depend entirely upon how government officials regard the paper situation during the next few months.

Hope for Specialty Papers

Some improvement in specialty paper supplies for other than war use is now likely, but it will probably be quite some time before distribution can take care of all needs and reserve supplies built up by distributors. Much specialty paper production during the war years has been diverted to military uses while civilian users had to get along as best they could. There is a large back-log of business from this source awaiting a greater availability of supplies. Wallpaper manufacturers, for instance, who were limited to a few lines during the war, will now, as soon as there is a free market, and a great increase in home making, require huge quantities of paper for new lines.

Containers Market Enlarged

Although all restrictions have been lifted on the placing of orders for containers by civilians, the industry itself is still subject to a paper board quota system. Manufacturers estimate that the industry will continue to operate at near capacity for another year or year and a half to catch up on civilian orders. It is said that even after the industry has caught up on itself it will operate at a level as much as 50% higher than before the war started. Increased business generally resulting from war spending has boosted sales of paper bags, boxes and other light containers 17% higher than pre-war days. Only about one-third of this gain represented war orders. Competition in the post-war period is expected to result in an increase in packaging. In the food and drug fields the demand for attractive combination packages is expected to reach new high levels. The new waterproof packages will be in high demand for certain purposes and many other war-developed ideas will enlarge the market for paper containers.

The Value of Research

Research during the war years has taught the pulp and paper industry many things, just as it has also taught those in other industries. During the last few years more progress has been made in developing and perfecting new processes and products from wood pulp and from the chemicals and compounds used in pulp and paper making than in several decades previously. With many critical metals in short supply, the paper industry was called upon to work out substitutes. This they were able to do in a commendable manner and they will now have the benefit of their endeavors in the peacetime uses of these many war-born products. Water-proofing papers, laminated papers, plastics, vanillan, yeast and other products are now being manufactured and are the results of intensive research in the pulp and paper industry, all of which makes for optimism in the industry.

Weston Buys into Sidney Firm

VANCOUVER, B. C., Sept. 25, 1945—W. Garfield Weston, Canadian capitalist, has now become a partner in the business of the Sidney Roofing and Paper Company, Limited, of Vancouver and Victoria. Announcement of Mr. Weston's entry into this business was made jointly by R. W. Mayhew, M.P., President, and Logan Mayhew, managing director of the organization. Logan Mayhew stated that the $250,000 expansion program of the company at its plant in Victoria, B. C., would be continued. In addition to the two plants of the company in Vancouver, the plant of the National Paper Box Company, which is a subsidiary organization of the Sidney Roofing, is also involved in the latest addition to the industries in which Mr. Weston has an extensive interest. It is expected that through the Weston association the National Paper Box plant will cater especially to the box needs of the wholesale grocery, confectionery, biscuit and bakery plants which are Weston controlled.

Hercules to Increase Rosin Output

WILMINGTON, Del., September 21—Hercules Powder Company announced today a $1,250,000 addition to its naval stores plant at Brunswick, Ga., now under construction, and expected to be producing by April 1, 1946. The new unit will add approximately 3,600,000 pounds of rosin and resinous products and 720,000 pounds of liquid products to the plant's monthly output.

Located in the heart of the Florida-Georgia pine belt, Hercules' Brunswick plant is one of the major wood naval stores producing plants in the nation.

RESULTS

1. Increased dryer capacity up to 30 per cent.
2. A reduction in fuel costs up to 15 per cent., with a corresponding increase in boiler capacity.
3. A substantial saving in maintenance.
4. Control that assures positive regulation of quality with manual effort practically eliminated.
5. Improved efficiency throughout.

STICKLE STEAM SYSTEMS FOR PAPER MILLS

● Stickle Drainage and Control, properly adapted to operating conditions, permits paper machines to perform, as nearly as possible, to their potential capacities. Such accessory installations as are indicated for given conditions, in addition, further reduce steam waste, cut steam costs and increase overall efficiency.

The Stickle Line of equipment as now constituted represents the developments and improvements resulting from 40 years of specialization in the paper manufacturing field. The flexibility of Stickle Equipment permits installations to be designed to meet the various phases of specific operating conditions. When preferred, the more pressing needs may be met immediately and further improvements added later with little or no penalty, or, older installations may be brought up to current effectiveness at reasonable cost and little inconvenience.

AUTOMATIC CONTROL

● Stickle Automatic Control assures better drying, more uniform quality and increased volumes of production. It stabilizes steam flow and checks overheating. Maintains an established moisture content within extremely close limits.

DIFFERENTIAL DRAINAGE

● Stickle Differential Drainage assures positive and rapid circulation of steam through dryers through the equally rapid elimination of condensate and air. Decrease in back pressure and reduction of waste in by-passing reduces costs and permits great increase in production capacity.

INDIVIDUAL TRAPS

● Stickle drainage system with use of individual traps is designed to meet the drainage requirements of machines operating at low pressures or on vacuum. Stickle installations are designed to completely meet the requirements of specific operating conditions.

SALVAGING B.T.U.s

● Stickle Boiler Return enables condensate to be placed back into boilers at a temperature corresponding to temperature at which it leaves dryers. This reduces use of boiler make-up water, eliminates over-flow waste, reduces fuel costs and increases boiler capacity. Stickle Blast Coil Heaters utilize B.T.U.s from condensate to heat and ventilate machine room and supplies other advantages. Stickle Heat Reclaimer reclaims heat from machine room vapors to preheat water for processing.

Ask for Your Copy of New Stickle Paper Mill Bulletin No. 160

STICKLE STEAM SYSTEMS
THE STICKLE LINE
Differential Drainage System
Differential Boiler Return System
Combined Flash and Receiver Trap
Automatic Steam Control
Automatic Tension and Thermal Attachment
Visible Micro Adjustable Orifice
Sight Feed Flow Regulator and Sight Glasses
Vacuum Blast Coil Heater
Heat Reclaimer
Open Float Steam Traps
Open Coil Feed Water Heaters and Other Specialties

Stickle

STEAM SPECIALTIES COMPANY

2215 VALLEY AVENUE • INDIANAPOLIS, INDIANA

Waste Dealers To Meet

The National Association of Waste Material Dealers, Inc., will hold a streamlined Fall Convention at the Hotel Sherman, Chicago on Wednesday and Thursday, October 24th and 25th. The object of the Convention is to give the Industry which has been unable to get together for some time an opportunity to consider problems which will face the Industry during the postwar era.

The program will center around the theme "What's Ahead for the Waste Material Industry?" and a special effort will be made to have at the meetings the most enlightening information possible both from the dealer and the consumer standpoint. The convention will open with a Membership Luncheon on Wednesday, October 24th and close with an Informal Dinner in the Grand Ballroom of the Sherman on the evening of the 25th.

Further important details in reference to the program will be available shortly according to a report from the Association's Executive Offices in New York.

P&W Advances Strub

At a recent meeting of the Board of Directors of Parsons & Whittemore, Incorporated, J. Francis Strub was elected to the office of Vice-President and was placed in charge of sales to the European continent. In June, 1944, Mr. Strub re-entered the service of P&W, after an interval of 14 years.

Mr. Strub is also Secretary and Treasurer of the United States Paper Exporters Council, Inc., an association of paper exporters actively engaged in promoting the industry's foreign trade. In keeping with the company's policy of rapidly resuming trade in liberated areas, arrangements have already been made for adequate representation in many of the leading industrial European centers.

UFORMITE 467

UFORMITE 467 provides high strength in food wrappers and bag stocks without imparting color, odor or taste!

THESE PRODUCT ADVANTAGES—

GREATER WET STRENGTH— Paper treated with UFORMITE 467 shows remarkably improved wet Mullen, tensile and tear values.

IMPROVED DRY PROPERTIES—Intended primarily as a wet strength resin, UFORMITE 467 also increases dry Mullen, tensile and fold strength.

FREEDOM FROM COLOR, ODOR, TASTE— UFORMITE 467 effects strength increases *without* imparting color, odor or taste. Vitally important in food packaging applications!

Blueprint, chart and map papers get increased wet and dry strength from UFORMITE 467!

THESE PRODUCTION ECONOMIES—

LOW COST— UFORMITE 467 is inexpensive and economical to use. As little as 1 per cent on the weight of the fibre produces excellent strength increases... makes possible the use of *less expensive pulp*.

REDUCTION OF ROSIN SIZE— UFORMITE 467 improves retention of rosin size... makes possible substantial reductions in amount required. Retention of other beater additives is also greatly improved..

EASE OF MIXING— Just add UFORMITE 467 at the beater—that's all! The resin can be used in any desired concentration... is uniformly dispersed throughout the stock.

Wet tensile and tear strength of paper toweling is stepped up by treating stock with UFORMITE 467!

THESE MANUFACTURING NUISANCES—

~~***NEW PROCESSES***~~... none to learn in using UFORMITE 467 — and no aging or pretreatment of the resin is needed.

~~***NEW EQUIPMENT***~~... not necessary with UFORMITE 467. Use your present equipment or methods. Just add UFORMITE 467 at the beater. You can actually reduce beater time by its use.

~~***SPECIAL CATALYST***~~ ... no need for one with UFORMITE 467. Only alum is required for beater treatment with resin.

UFORMITE is a trade-mark, Reg. U. S. Pat. Off.

THE RESINOUS PRODUCTS & CHEMICAL COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Bolton Winners Get Their Bonds

The Superintendents Association has just announced the National Winners in the Bolton Award Contest. First prize, a $500 war bond, was won by Kenneth J. Mackenzie, assistant superintendent of paper mills for the Eastman Kodak Co., Rochester, N. Y. Second prize, $300 in war bonds, went to Charles A. Shoudy, paper mill superintendent of the West Virginia Pulp & Paper Co., at Charleston, S. C. Third prize, $200 in war bonds, was awarded to Edward T. Jones, formerly of Brown Co., Berlin, N. H., and now with Charles T. Main, Inc., Boston, Mass.

The book containing these articles will shortly be published by John W. Bolton and Sons, Inc., and will be distributed by them. It contains the opinions of men on the job and in supervisory positions. A new Bolton contest for 1946 will shortly be announced.

Forestry School Names Illick Dean

SYRACUSE, N. Y., September 17, 1945—Dr. Joseph S. Illick was named dean of the New York State College of Forestry at Syracuse University by members of the board of trustees at a special meeting in the college Thursday. Dr. Illick has served as acting dean since 1943. Formerly state forester of Pennsylvania, he came to the New York State College of Forestry as special lecturer in silviculture in 1931. He became head of the department of forest management the following September.

Albarranc Visits United States

Adrien Albarranc, consulting engineer, of Papeteries Navarre, 7 Rue de Teheran, Paris 8, France, is on a three-months visit to the paper and pulp mills of the United States.

WARREN PUMPS
Warren Stock Pump
Type 2-SOD-11 and 3-SOD-11
Warren Stock Pump
Type 5-SOD-15 . . . 12" suction nozzle
For all Paper Mill Services including
Liquor Pumps in Sulphite, Soda and Kraft Mills
Pulp Stocks up to 7% density
Water pumps for Mill Supply, Showers, White water, Wash-down, etc.
Boiler feed and all other power-plant requirements.
CENTRIFUGAL
RECIPROCATING
Warren Double Suction Pump
Single Stage
Warren Machine Chest Pump
Warren Digester Liquor Circulator
Type 10-LS-19
Warren Liquor Pump, Type "L"
Single-stage, Single-suction
WARREN STEAM PUMP CO., INC.
WARREN, MASSACHUSETTS

Obituary

Arthur B. Hull

SPRINGFIELD, Mass., Sept. 22—The Package Machinery Corporation announced today the recent death of Arthur B. Hull, 64, of 325 East 57th street, New York City, sales engineer for the concern since 1927.

Born in Hawley, Pa., on Sept. 4, 1881, Hull attended Columbia University School of Engineering.

A sales engineer for many years, Hull was formerly connected with Ferguson & Hass, New York, and with the American Trading Corporation of New York, during which he traveled extensively in Japan and the Orient. He joined the staff of Package Machinery 18 years ago and had been attached to its New York office.

Surviving are his widow, Kathleen Latham Hull; a daughter, Miss Elizabeth T. Hull of Colonia, N. J., and a son, Robert Hull of Suffield, Conn. The first Mrs. Hull, the former Miss Edith Torrey, died in 1940. Funeral services were held in New York and burial was in Fairfield, Conn.

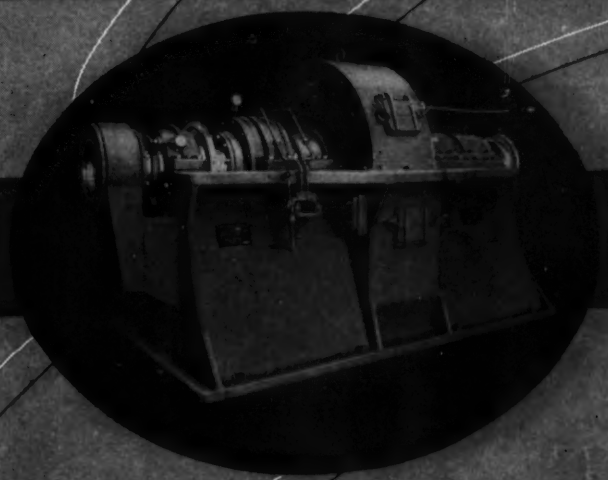
C. R. Wood

ST. LOUIS, September 22, 1945—C. R. Wood, of Webster Groves, Missouri, who has been sales representative of River Raisin Paper Company in the St. Louis territory for the past twenty-seven years, died in Deaconess Hospital, St. Louis, Missouri, September 19. Burial was at Kokomo Indiana, September 21.

A. E. Quere

Arthur E. Quere of A. E. Quere Company, Rockefeller Building, Cleveland, Ohio, Sales Agents for the Hendrick Manufacturing Company, Carbondale, Pa., in the states of Ohio, Kentucky and Indiana, died August 18th.

CONTINUOUS BEATING AND REFINING FOR EVERY PAPER MAKING FIBER by SUTHERLAND



SUTHERLAND REFINER CORPORATION . . . TRENTON, N. J.

SUTHERLAND REFINER LIMITED . . . . . MONTREAL, QUE.

Downingtown Promotes Ed Street

DOWNINGTOWN, Pa., September 25, 1945—E. T. Street, who has been associated with the Downingtown Manufacturing Company for 16 years, has been appointed vice-president in charge of sales, succeeding the late Jacob Edge. Prior to this he was in

ED. STREET

charge of engineering. In this capacity, his work was the design and development of new equipment and assisting the sales department in the sale of special machinery. He developed Downingtown Wallboard Machinery, projected by the late Mr. Edge, and today this equipment is operating from Sweden to Australia and from Minnesota to Florida. At the present time, the company is building Wallboard machines to be installed in Australia, Louisiana, Minnesota and Washington.

Before his association with Downingtown, Ed Street was, for ten years, chief engineer for the Ruberoid Company, where he designed special machinery, built additions to various mills, designed and built a felt mill in England, designed and started the first asphalt oxidizing unit in England and designed the first asbestos cement pilot plant for the Ruberoid Co. in the States.

Prior to his association with the Ruberoid Co., Street was superintendent of Power for the Minnesota and Ontario Paper Co., International Falls Minnesota, for two years.

Leatherman & Mertz Represent Edward

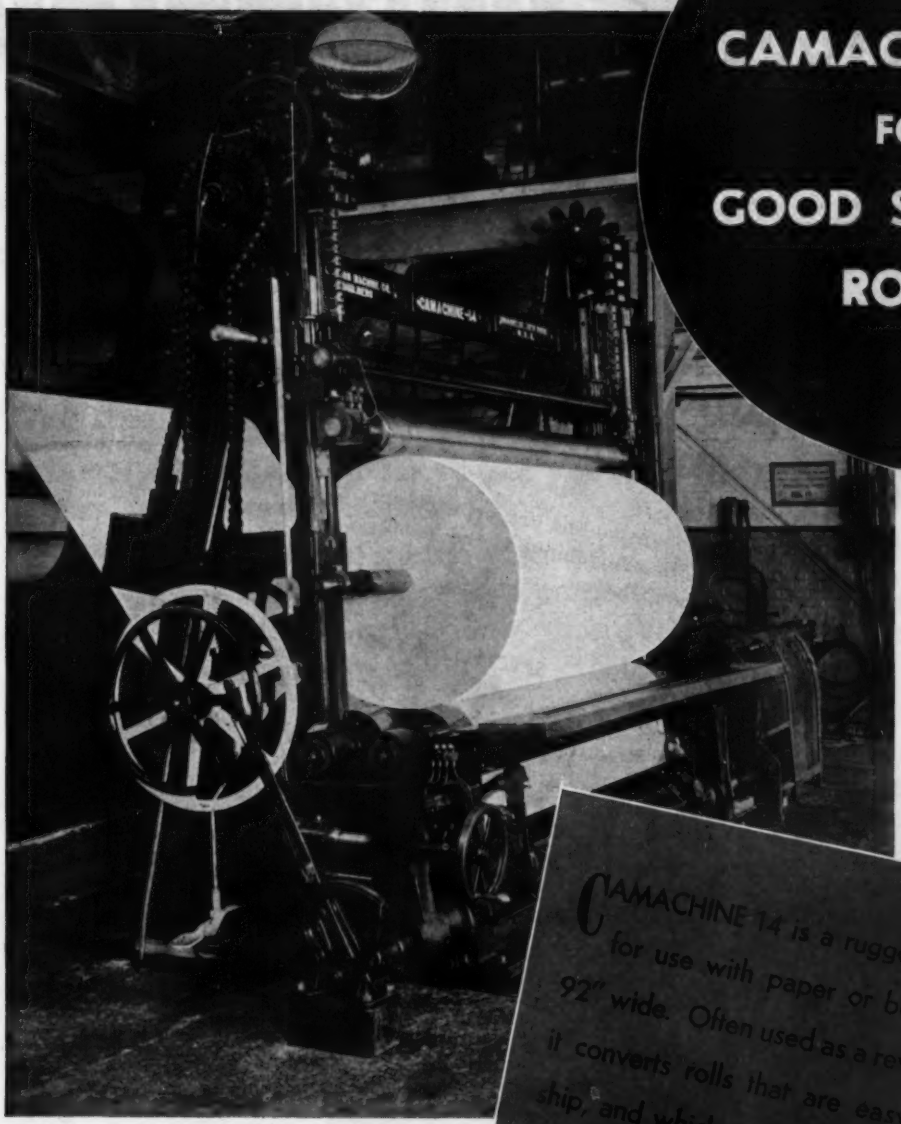
EAST CHICAGO, Ind.—Effective September 1, 1945, The Edward Valve & Mfg. Company., Inc., has appointed Leatherman & Mertz as its representatives for all of Michigan, excluding the upper peninsula. Offices are in the Book Building, Detroit 26, Michigan.

Lloyd Leatherman, for 20 years a sales and service engineer in the power specialty field in Detroit, is a former power plant operator. Charles M. Mertz, a graduate mechanical engineer from Penn State college, has been associated with a large boiler company in its Detroit office for 15 years.

Sutherland Votes Dividends

The Sutherland Paper Company reports that stockholders of record September 1 will receive a quarterly dividend of 30 cents per share on September 15. This is the same dividend rate as was paid in the previous quarter.

CAMACHINE 14 FOR GOOD SHIPPING ROLLS



CAMACHINE 14 is a rugged, high speed winder for use with paper or board machines up to 92" wide. Often used as a rewinder in larger mills it converts rolls that are easy to handle also to ship, and which are a credit to the mill supplying them. Be sure to include CAMACHINE 14 in your postwar plans. Write today for information.

CAMERON MACHINE COMPANY - 61 POPLAR ST. BROOKLYN 2, N. Y.

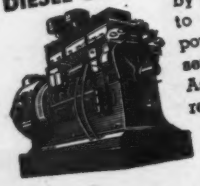
Midwest Office: 111 W. Monroe Street, Chicago 3, Ill.

TURN TO TYCOL "Engineered

ENGINEERED SOLUTIONS TO YOUR LUBRICATION PROBLEMS *at your fingertips*

Tycol lubricants are made in a comprehensive line to meet each specific service requirement. Their performance-proved lubricating ability is the result of modern scientific engineering and rigid testing. The line includes:

DIESEL OILS of 100% paraffine base, refined by the most modern processes to eliminate unstable compounds that would oxidize in service. There is a Tide Water Associated Oil for every Diesel requirement.



SPECIALIZED INDUSTRIAL LUBRICANTS for all types of machinery in all types of industry — from steel to textile.

GREEN CAST GREASES, made from paraffine base cylinder oil with a minimum of soap . . . extremely economical, giving greater lubrication per pound than do conventional greases.

TURBINE OILS with great stability and resistance to emulsification . . . free from sludge-forming hydrocarbons . . . engineered to inhibit Rust.

VEEDOL MOTOR OIL, refined from 100% Pennsylvania Crude by Tide Water Associated's triple-refining process, which produces that tough "film of protection" — famous all over the world.

CYLINDER OILS refined from 100% Pennsylvania Crude. They have exceptionally high resistance to breakdown under high temperature operation.

Any Tide Water Associate office will help you select the oil or grease best suited to your needs.

Drums! Drums! Drums!

War needs make it imperative that all empty drums be returned immediately.

TYCOL INDUSTRIAL

ENGINEERED FOR EVERY

Lubrication"

FOR GREATER SERVICE...LONGER LIFE

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W. L. Cook, Editor

DECLINE IN NEWSPRINT OUTPUT

The charted trend of newsprint production in the United States shows a gradual decline over a period of many years. The domestic output of newsprint in 1944 was the lowest of any recorded year since 1900. In reporting to the Newspaper Industry Advisory Committee of the War Production Board, the task group presented the following analysis: Production of newsprint by United States mills has declined 44% in the last twenty years, while production capacity has dropped to less than 50% of what it was in the peak production year of 1926. The report pointed out that domestic mills only produced 21% of the newsprint used in the United States today, and urged continued coöperation between industry and the Government to increase our output.

In its statistical study showing decreased production, mill capacity and the number of newsprint producing mills the report is as follows: In 1926, production was 1,684,000 tons, against a capacity of 1,739,000 tons in 39 mills: in 1942, production was 953,000 tons, against a capacity of 1,126,000 tons in 17 mills; the estimated production for 1945 is 734,000 tons, against a capacity of 981,000 tons in 12 mills; and in 1946 the estimated production is 741,000 tons, against a capacity of 839,000 tons in 8 mills.

The report states that, continued falling off of production was predicted, indicative that by 1948 there would be but five United States mills manufacturing newsprint with an expected production of only 613,000 tons. The gradual reduction in the number of domestic newsprint mills from 39 in 1926 to 12 today, and also the decreased production reported by manufacturers, is due to competition from foreign mills, imports from Europe at prices considerably under the domestic market, as well as the inability of many United States newsprint mills to earn a return on investments comparable with profits in other fields, the task committee said. It was also reported that, since Government price controls were introduced in 1942, wartime increases in pulpwood, labor and other manufacturing costs have accelerated the diversion from newsprint to more profitable types of papers. United States sources of newsprint supplies have shifted materially in the past 32 years, the report disclosed. In 1913, United States mills manufactured 85% of the total newsprint used in the United States, and Canadian mills supplied 15%. Today, our own mills produce only 21% whereas Canadian mills supply 74% and others 5%.

In conclusion the report states that there was no basis for expecting any material increases in United States newsprint production, or a higher rate than the current production of about 734,000 tons a year. Production during the balance of 1945 and in 1946, it was said, depends largely on the cooperation of the Canadian Government in its regulation of wood shipped to the United States, and border labor costs. Cheap power, fuel, pulpwood and a large capital investment were said to be the prime requisites of any modern newsprint mill; a combination found in but a few locations within the United States. However, increased Governmental efforts, at least during the life of the War Production Board, toward improved domestic newsprint production were urged.

PAPER STOCKS AND SHIPMENTS

The index value of manufacturers' shipments of paper and allied products for July, 1945 declined to 161, from 187 in June, compared with 171 in January, 1945. In 1944 the index was 179 in June, with a low of 165 in July. This compares with an index figure for all industries in July, 1945 of 237, and 268 in June; with total durable goods of 304 in July, and with 355 in June, and with total non-durable goods of 190 in July and with 207 in June.

The index value of manufacturers' inventories of paper and allied products for July, 1945, was 139.6, compared with 135.1 for June, and with 131.8 for January, 1945. The index in July 1944, was 143.4 and in June, 139.8.

In commenting on manufacturers' shipments, the Department of Commerce stated that, the value of manufacturers' shipments dropped $1,500,000 from June. The July deliveries amounted to $11,400,000 or 12% below those in June for all industries. While shipments tapered somewhat after V-E Day, it was not until the third month of the one-front war that deliveries made by manufacturers decreased significantly. The July volume was 6% below a year ago, and on a seasonally adjusted basis dropped to the volume of shipments made in January, 1943. Sharper curtailments of deliveries of war goods will result in further cuts in total shipments of manufacturers in the coming months. All industries in the durable goods group showed significant declines. All of the non-durable goods industries also reported smaller shipments in July than in June. The value of inventories remain virtually unchanged for all industries. At the end of July they were valued at $16,300,000, slightly above June but 6% below July, 1944.

The minor rise in the value of industrial stockpiles was accounted for by the non-durable goods industries. Each of the non-durable goods industries reported increases in the value of their inventories. Raw materials inventories, goods in process and finished goods inventories each remained at their June levels. In general, the gross volume of current inventories is inadequate to assure the maintenance of a high level of activity.

U. S. Envelope at Full Schedule

SPRINGFIELD, Mass., September 22—Running at full schedule, with few problems in the changeover from wartime to civilian production, the United States Envelope Company plant in this city has a backlog of about eight weeks' civilian orders, Eldon V. Johnson, general manager, said today. Because the backlog of orders in normal times is about four weeks, Johnson said, the P. P. Kellogg company division is still on a 48-hour week basis and will remain that way for the present.

Employment now is at 750, with only one shift, and the firm has no labor shortage problems. During the war, however, when general labor shortages were most acute, the number of persons on the payroll dropped to about 600. Paper shortages during the war have been relieved, Johnson said. He predicted there would be developments in the company's cellophane product line, but he said he could not discuss them publicly at this time.

Production is not being delayed by a machinery shortage, Johnson added, although some new machinery is on order and is expected soon for installation. Materials shortages have not hampered to any degree production of civilian materials.

Greenfield Plants Seek More Men

GREENFIELD, Mass., September 8—Franklin County paper mills are meeting reconversion to postwar production with little difficulty after three years of turning out war materiel. Both the Esleeck Manufacturing Company and the Keith Paper Company of Turners Falls report no cancellations of war orders of any consequence and said they will continue making their regular grades of papers with no cutback in employment.

David Housen, president of the Erving Paper Mills, reported no reconversion problems, and said the concern has plenty of domestic business. He said the company could use 100 more men and women at once.

Production Ratio Report*

(Production as per cent of six-day capacity)

COMPARATIVE WEEKLY SUMMARIES

Current Weeks—1945		Corresponding Weeks—1944	
Aug. 11	93.0	Aug. 12	91.2
Aug. 18	67.8	Aug. 19	90.4
Aug. 25	95.4	Aug. 26	92.2
Sep. 1	95.2	Sep. 2	89.4
Sep. 8	75.9	Sep. 9	74.4
Sep. 15	*94.0*	Sep. 16	92.8

COMPARATIVE MONTHLY SUMMARIES

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Avg.
1944	88.7	88.5	88.1	87.6	88.7	89.8	80.3	90.6	88.2	92.5	90.6	92.4	88.1
1945	86.7	89.4	90.2	88.1	89.8	91.2	80.8	*88.6*					

COMPARATIVE YEARLY SUMMARIES

	1938	1939	1940	1941	1942	1943	1944	1945
Year to date	69.1	79.1	86.2	94.7	92.4	88.0	87.7	*87.8*
Year Average	71.5	83.4	85.6	97.4	90.4	87.8	88.1	

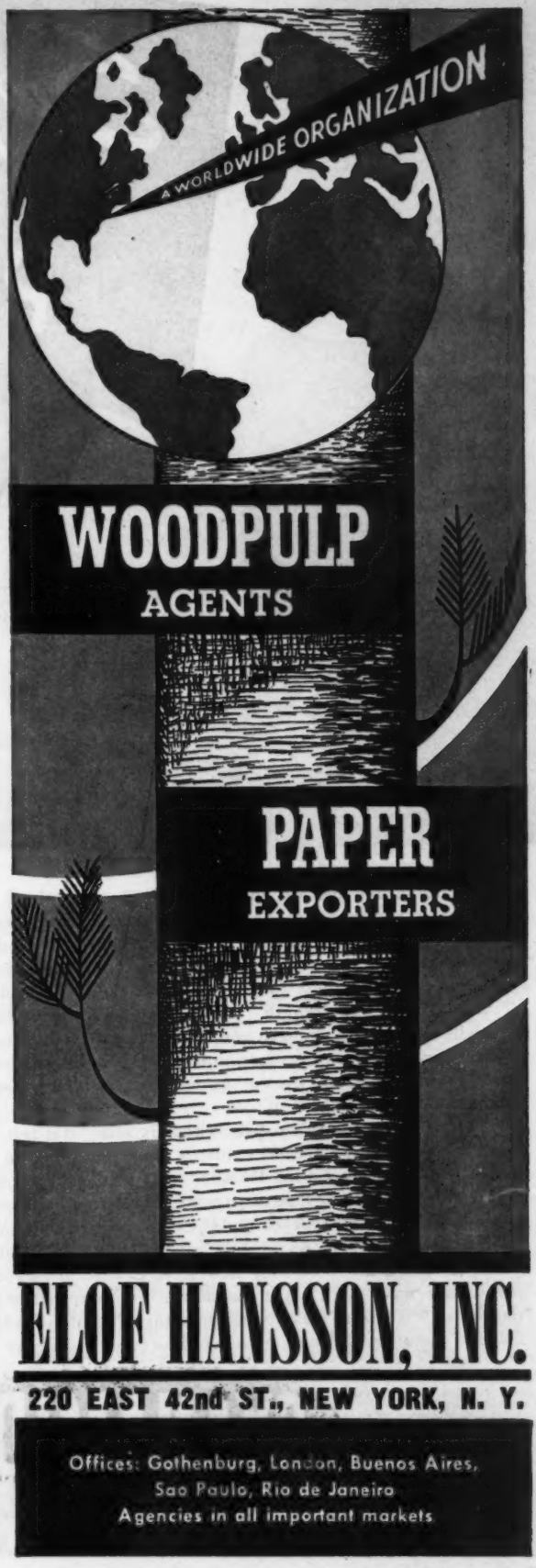
*Based on tonnage reported to American Paper and Pulp Association. Does not include mills reporting to National Paperboard Association, except in isolated cases where both paper and paperboard are produced and separate tonnage figures are not readily available. Does not include mills producing newsprint exclusively.

PAPERBOARD OPERATING RATIOS†

Current Weeks—1945		Corresponding Weeks—1944	
Aug. 11	94	Aug. 12	96
Aug. 18	67	Aug. 19	95
Aug. 25	99	Aug. 26	96
Sep. 1	97	Sep. 2	97
Sep. 8	80	Sep. 9	80
Sep. 15	96	Sep. 16	97

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Avg.
1944	90	96	95	96	96	96	85	96	92	95	95	85	93
1945	91	95	97	97	96	96	86	*90*					

†Per cents of operation based on "Inch-Hours" reported to the National Paperboard Assn.



Among the things that Mr. and Mrs. Consumer may look forward to will be new surprises in frozen foods. For new ways have been found to capture and hold that garden-fresh flavor of vegetables and fruits—and the unique savour of meats and fish. But one of the most interesting of the surprises will be the packages in which these foods will come. Look at the inner wrapper. Now . . . it is "high wet-strength" paper—paper that is extra strong when dry and will not lose its strength and fall apart even when soaking wet! Thus it gives a new measure of protection to foods . . . new convenience to the user . . . a real selling feature for the producer and retailer . . . *and a new profitable specialty for paper-makers!*

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The Hot Alkaline Purification of Cellulose I.

By Alexander Meller[1]

Abstract

A survey and discussion of the literature on the action of hot alkali on cellulosic materials.

The present survey of the literature on the hot alkaline purification of cellulose aims to bring together the results and discussions related to the subject published in the last twenty years. It is not claimed that the review is complete but is confined as much as possible to published work which contributed to the advance of knowledge about the action of dilute alkali solutions at higher temperatures on cellulosic materials for the production of purified cellulose. It has not been possible to include patent literature in this review.

The action of strong cold alkaline liquors on cellulosic fibers has been surveyed, and comprehensive reviews are included in various textbooks and handbooks on cellulose chemistry or on pulping. However, these textbooks or reviews do not contain separate chapters dealing with the action of hot dilute alkaline liquors on cellulose, or on cellulosic materials. Thus the present survey may fill in this gap as well.

The survey treats the subject under the following headings: (A) Introduction, (B) the hot and cold purification processes and their applicability, (C) a comparison of the behavior of sulphite and sulphate pulps in the hot alkaline refining, and (D) the action of alkaline solutions at higher temperatures on cellulose, pulps, and on wood.

A. Introduction

The purification or refining processes for cellulosic materials are designed for the removal of all constituents of the fibers, except cellulose, and by doing so to obtain products similar to cotton.

In order to obtain very pure fibers from cellulosic materials, such as woods, special purification processes must be applied since the common fiber liberation or cooking processes and the bleaching processes do not result in fibers of high purity as are required for certain purposes. The commonly processed wood pulps, i.e., cooked and bleached products, contain considerable quantities of hemicelluloses, such as degraded cellulose, pentosans, polyuronides, and some hexosans of noncellulose nature. Thus the purification processes are primarily concerned with the removal of these substances, and secondly it is required that this removal should not be accompanied by a serious degradation of the noble (high polymeric, long chained) cellulose. Hence the principal aim for an efficient purification process is to apply a chemical which under certain conditions should act selectively insofar as it should remove only hemicellulosic materials and not degrade below certain limits the longer-chained cellulose of the pulp. This chemical must necessarily be obtainable easily and inexpensively, and its consumption and recovery will furthermore influence the economy of the purification process.

For these two reasons—efficiency and economy—it seems not accidental that caustic soda is perhaps the most commonly used chemical in the wood pulp purification industry. Caustic soda applied to wood pulps (and to other cellulosic fibers) exerts a selective action, insofar as it removes hemicelluloses extensively under certain conditions without degrading considerably the cellulose, therefore, it may be regarded as an efficient purifying chemical. Its consumption in the process does not influence materially the economy of the purification process.

B. The Hot and Cold Purification Processes and Their Applicability

The generally known alkaline purification processes, intended to produce materials suitable for the cellulose-derivative industries, operate either at relatively low temperatures (room temperature, or below) with the use of strong alkaline liquors; or at higher temperatures (80 to 120°C.) using relatively weak alkaline liquors (0.5 to 2% NaOH solutions) *(1, 2, 3)*. The former is referred to in the industry as the cold alkaline purification process and the latter as the hot alkaline refining process.

So far, the hot alkaline treatment seems to have been successful only when applied to sulphite pulps and has not proved applicable to alkaline cooked cellulosic materials. As an expedient, it is usually inserted between the chlorination and hypochlorite bleaching stage in a multistage bleaching process. Since the alkali used in the hot purification of the chlorinated sulphite pulp is weak, the alkali of the spent liquor does not need to be recovered.

The cold alkaline process has been applied to sulphite and sulphate pulps *(4)*. Usually partly or fully bleached pulps are subjected to a treatment with strong alkaline liquors. A subsequent washing of the pulp free of alkali as well as the recovery of the caustic soda are of high importance, being the main factors upon which the economy of the cold alkaline refining process depends *(5)*.

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It should be mentioned that, by a combination of hot and cold alkaline treatments, pulps can be produced with optimum characteristics such as high alpha cellulose content, low pentosan content, high reactivity and absorbency, and so on.

C. A Comparison of the Behavior of Sulphite and Sulphate Pulps in the Hot Alkaline Refining

Since the hot alkaline purification process has not yet been successfully applied to alkaline cooked cellulosic materials, it appears worthwhile to survey the literature on the behavior of sulphite and sulphate pulps towards hot alkali, and by making comparisons of their behavior, a possible explanation of the unsuitability of sulphate pulps for the hot alkaline purification process may be advanced.

According to G. A. Richter *(6)*, pentosans in wood pulps are heterogeneous; their behavior suggests that they are a mixture of "alpha-beta and gamma pentosans." The hydrolysed hemipentosans are readily attacked by alkali, whereas the more resistant portion ("alpha-pentosans") behaves in much the same manner as does alpha celluose. According to the same author, sulphite pulps from hardwoods are richer in the resistant pentosan fraction than softwood pulps. As regards kraft pulps, he states that, "as would be expected," the hot refining process cannot be used successfully.

E. Lindpaintner *(7)* establishes three main properties of fibers, which determine the conditions to be applied in the alkaline purification process. These three important factors are:

(1) The strength of the linkage between cellulose and pentosans, (2) the polydispersity of the fiber constituents, and (3) the morphological and fine structure of the fibers.

These three fiber characteristics are decisive in choosing the conditions, such as temperature and caustic concentration, for the alkaline refining process.

1. The Strength of the Linkage between Cellulose and Pentosans.

This is measured, according to this author, by determining the total material removed from the pulp in question when this has been treated with caustic solutions of different strength; and the pentosan content of the refined pulps. The higher the yield after the treatment with alkali, and the lower the pensotan content of the refined pulp, the weaker can be regarded the linkage between cellulose and pentosans in the unrefined pulp. Lindpaintner postulates the linkage between cellulose and pentosans as of a physical nature. In this connection it should be recalled that the existence of a bond between cellulose and pentosans and the nature of it are still much discussed.

E. Schmidt *(8)* regards this bond in cellulosic materials as an ester linkage.

A. G. Norman *(9)* advanced the idea that in plant materials there may be present mixed chains, that is chains containing both cellulose and xylan units. The presence of such mixed chains might account for the extreme stability of a small proportion of the xylan which resists extraction by boiling with caustic soda solutions.

The second view would be, according to W. T. Astbury, R. D. Preston, and A. G. Norman *(10)* that the xylan molecules in some fibers participate in the micelles and are oriented in the same direction as the cellulose chains. This would mean that the incorporation of xylan is a sort of mixed crystallization.

K. H. Meyer *(11)* does not exclude the possibility of a close association of certain hemicelluloses with cellulose but points out the difficulty of obtaining experimental evidence by chemical (separation) or by physical (x-ray) methods since the methods are not perfect. Even in case of a complete separation of the components of fibers by chemical methods it is often impossible to decide whether sugars and uronic acids obtained by hydrolysis were originally associated as units in the same molecule or in different chains. The x-ray diagram, on the other hand, only shows the presence of bundles of pure cellulose chains in the fibers, and does not indicate the existence of linkage with xylan or with other hemicelluloses.

Lindpaintner—by investigating sulphite and sulphate pulps—found that, the linkage between cellulose and pentosans is relatively weak in sulphite pulps and in drastically cooked kraft pulps.

2. Polydispersity of Cellulose.

According to Lindpaintner, the polydispersity of cellulose, that is the distribution of chains of different length, influences the behavior of pulps in the alkaline refining process inasmuch as it determines the most suitable temperature to be applied. This aspect, and the importance of polydispersity advanced by Lindpaintner, find a strong support in the generally accepted modern concept according to which the reactivity of fibers is dependent on the distribution of cellulose and pentosan chains in them. Thus the polydispersity will influence the rate (and presumably the extent) of removal of pentosans and of cellulose in the alkaline refining process *(12)*. Lindpaintner points out, however, that the removal of pentosans is hardly affected by temperature between —5 and +90°C., whereas the degradation of cellulose is markedly influenced by temperature. It should be mentioned that he measured the extent of pentosan removal for a constant time thus the rate of removal can still be dependent on temperature. On the other hand, the slight influence of temperature on the pentosan removal for a constant time could perhaps find an explanation in the results of E. Husemann *(13)*, who, by extracting xylan with caustic soda from beech wood and determining its polydispersity, found no significant polymolecularity. A fairly uniform degree of polymolecularity was characteristic for the xylan-fraction extracted (presumably the easily soluble xylan!), and similarly a uniformity of polymerization was found by the same author for mannan extracted from spruce.

Lindpaintner's polydispersity measurements showed that the sulphite pulps investigated contained a large proportion of short chained material (below 150 D.P.), while the sulphate pulps investigated contained much less of these short chained constituents.

It should be remembered that the chain length distribution in fibers will largely depend upon the methods of cooking and bleaching them and the conditions used in these operations. Thus J. E. Atchison *(14)* showed that spruce wood pulped by the sulphite, sulphate, and soda processes resulted in pulps with rather different polydispersity. In pulping generally an equalization occurs inasmuch as the amount of material of medium chain length increases, since the long chain material becomes degraded, and the very short chains disappear. This equalization, is, according to Atchison, the greatest during sulphate cooking. On bleaching, further changes in the chain length distribution occur, which, however, result in a more heterogeneous product.

3. The Influence of Morphological and Fine Structure of Fibers.

According to Lindpaintner, the ease or difficulty

of removing hemicelluloses are closely related to the fine structure of the fibers. He measures the magnitude of this influence of the morphological structure by estimating the degree of polymerization of the materials dissolved in strong caustic soda solutions at 0°C. In the cases investigated by him, the degree of polymerization of materials in the solution originating from sulphite pulps are generally lower than those of the sulphate pulps, indicating a higher alkali sensitivity. (A comparison can, however, hardly be made because the raw materials for producing the sulphite and sulphate pulps were different).

It should be recalled that the influence of morphology of cellulose (and of fibers generally) on the reactivity was recently extensively studied by several authors *(15, 16, 17, 18, 19, 20)*. The results of these studies show that the distribution of amorphous and crystalline portions in cellulose preparations (easily and difficultly accessible areas) markedly influences their reactivity towards acid and oxidizing agents.

N. A. Rosenberg *(21)* advances the idea that pentosans in wood pulps behave somewhat similarly to gelatine: they swell with caustic soda but need to be heated to go into solution. According to this author, hot dilute alkali treatment on sulphite pulp brings about sometimes an increase in cuprammonium viscosity indicating that both pentosans and shorter chained celluloses have been removed simultaneously. Treatment with strong alkali at lower temperatures results in very little change in viscosity, indicating that mainly pentosans have been removed. A. Meller (unpublished work) found that the viscosity in cuprammonium of cold alkaline refined pulp obtained from bleached sulphate softwood pulp increases in some cases. From the analytical and yield figures of the unrefined and refined pulps (total removal and pentosan removal) it could be computed that negligible amounts of cellulose were removed, thus the increase in viscosity can be ascribed to an enrichment of the pulps in cellulose since considerable quantities of pentosans have been removed. According to Rosenberg, the hot alkali treatment is not satisfactory for increasing the alpha cellulose content and decreasing the pentosan content of sulphate pulp, the pentosans being strongly bound to cellulose in this type of pulp. He states that the process is much more successful when applied to sulphite pulps. He also points out that very little is known of the laws governing the removal of hemicelluloses from pulps.

According to W. Klauditz *(22)* deciduous woods contain an "easily soluble xylan" fraction (soluble in 0.2% NaOH solution) a "difficultly soluble xylan" fraction (soluble in 7% NaOH solution), and a "resistant pentosan" fraction (not soluble in 7% NaOH solution).

In the sulphite cooking, the cooking acid hydrolyses the "easily soluble xylan" fraction whereby water soluble monomers are formed. The acetyl groups of the "difficultly soluble xylans" are split and because of extensive hydrolytic degradation a large portion of this fraction becomes soluble in water. The "resistant pentosans" are also hydrolysed and become extensively soluble in alkali. This hydrolytic degradation of pentosans is accompanied by a degradation of cellulose, and its extent depends upon the conditions applied in the sulphite cooking.

In the cold alkaline refining of beech sulphite pulp, the "difficultly soluble xylan" portion is dissolved, but a certain portion of the "resistant pentosans" which have not been depolymerized sufficiently in the cooking process, remains in the cold alkaline refined pulp. In the hot alkaline purification of sulphite pulps, "difficultly soluble xylans" and "resistant pentosans" are converted into saccharinic acids by the action of alkali at higher temperatures whereby soluble sodium salts of these acids are formed. It is postulated that the formation of such saccharinic acids is caused by a "disproportionation" of the aldehyde groups of the depolymerized carhohydrates. According to this postulation, the chemistry of cold and of the hot alkaline refining reactions is basically different. The "disproportionation" is not explained in detail by this author, but presumably it refers to a Cannizarro type of reaction in which an aldehyde is converted into an acid and into an alcohol. It should be mentioned that G. L. Godman, W. N. Haworth, and S. Peat *(23)* showed with acid-permanganate oxidized cotton cellulose (oxycellulose), when boiled with dilute sodium hydroxide solution, that saccharic acids and other carbonic acids are formed similar to ones obtained when simple sugars are boiled with alkaline solutions. Whether in the formation of saccharic acids from carbohydrates in wood pulp by the action of hot alkali atmospheric oxygen takes part, or they are formed because of "disproportionation," has not yet been clarified. Haworth and collaborators obtained these acids also in the absence of air when the extraction of oxycellulose was performed with barium hydroxide.

According to Klauditz, in the usual alkaline pulping process, contrary to sulphite pulping, the hydrolysis leading to depolymerised pentosans is much less extensive. Applying higher OH ion concentrations in the alkaline pulping, the "difficultly soluble xylans" can be removed and the "resistant pentosans" converted into a degraded form. This, however, is always accompanied by a drastic attack on cellulose. Usually, therefore, the depolymerisation of "resistant pentosans" during alkaline pulping is only achieved by a great degradation and sacrifice of cellulose while the depolymerization brought about by the sulphite process is extensive and is accompanied with much less degradation of the cellulose.

V. F. Maksimow *(24)* postulates that in the cold alkaline refining process an intramicellar swelling occurs, by which the caustic soda penetrates inside the cells and dissolves the deeply embedded hemicelluloses. In the hot process, the alkali acts from the surface of the micelles and is able to penetrate deeper only by destroying the cellulose. This author thus clearly refers to a fundamental difference in the molecular mechanism of the cold and hot alkaline purification processes of wood pulps.

A. Meller (unpublished work) found that the resistant pentosan fraction of sulphate pulps—as measured by the pentosan content of the residue, insoluble in 17.5% sodium hydroxide solution—depends upon the cooking and bleaching conditions under which the pulps were produced. Thus by drastic cooking or by bleaching, the resistant pentosan content decreases. Usually, however, this decrease in the resistant pentosan fraction is accompanied by a degradation of cellulose rendering them unsuitable for the hot alkaline refining process. This observation would then appear to be in accordance with Maksimow's postulation on the mechanism of the hot alkaline action on fibers, namely, the reaction proceeding from the surface of the micelles would reach the deeper embedded hemicelluloses only by destroying some of the cellulose, the latter would become so weakened that the degraded cellulose may not withstand the action of the hot alkali. In other words, with sulphate pulps having a low proportion of resistant pentosan, the rate of degradation and solubili-

sation (removal) of cellulose by weak alkali at higher temperatures would be higher than the rate of removal of pentosans, leading to pulps with still high pentosan contents.

SUMMARY

In summing up the work and reasoning devoted to explaining the difference in behavior of sulphite and sulphate pulps towards dilute hot alkali, one may say that:

1. Alkaline cooked cellulosic materials contain a larger proportion of resistant pentosans than acid cooked pulps.

2. The linkage—which may only be hypothetical—between pentosans and cellulose in alkaline pulped materials is stronger than in acid pulped ones.

3. The hot alkaline purification process has not been applied successfully to sulphate pulps.

4. The reason for the nonsuitability of alkaline pulped cellulosic materials for the hot alkaline refining process has not been clarified conclusively, but evidently during the usual alkaline pulping the pentosans present in wood do not become sufficiently depolymerized and thus are present in the pulp in such a form that they resist removal by means of hot dilute alkali.

5. The suitability of sulphite pulps for the hot alkaline refining process seems to be associated with the more depolymerized pentosans present in such pulps. These extensively depolymerized pentosans are removed by hot dilute alkali according to a chemical mechanism, the exact nature of which is not known. The particular distribution of cellulose chains in sulphite pulps contributes to their resistance to degradation by the action of hot weak alkaline liquors. Extensive depolymerization of pentosans accompanied by particular distribution of cellulose chains and particular morphology appear to be inherent in sulphite pulping.

Finally, in seeking the reasons for the different behavior of sulphite and sulphate pulps when exposed to the action of caustic soda solutions at higher temperature, the inherent differences between different cellulose preparations should be considered. According to K. H. Meyer (*25*), the differences in cellulose preparations may be because of:

(1) Differences in mean chain length, (2) various degrees of homogeneity with respect to chain length, (3) presence of glucuronic acid or xylan residues in the chain, (4) associated substances, (5) degree of orientation, (6) crystal structure, (7) breadth of the crystallites, (8) pores, and (9) arrangement of micelles and chains on the surface of the fiber and in the interior.

Obviously, only after elucidating a good many of these characteristics of the two types of wood pulps (sulphite and sulphate), can we expect to obtain the satisfactory answer to the question put forward.

D. The Action of Alkaline Solutions at Higher Temperatures on Cellulose, Pulps, and Wood

Taking into account that relatively few of the above quoted factors of the two pulp classes are known, the question arises, what is known altogether about the reactions involved when cellulosic materials are exposed to the action of aqueous alkali solutions at higher temperatures. This would include knowledge about the rate of removal of constituents of celluosic fibers, as well as the mechanism of the main reactions involved in the process, when these materials are exposed to the action of hot alkaline liquors.

It appears useful to treat this aspect under the following headings:

1. Solubility and reactivity of cellulose; reviewing the generally accepted concepts on reactivity and reactions of celulose in liquid medium, and on solubility in alkali.

2. The action of alkali solutions at higher temperatures on:

(a) Cellulose, containing inappreciable quantities of accompanying substances, including modified cellulose, such as hydro- and oxycellulose.

(b) Pulps, obtained by different pulping processes, including unbleached and bleached materials, the latter containing practically only cellulose and hemicelluloses, and

(c) woods and other lignified plant materials.

1. Solubility and Reactivity of Cellulose

Before surveying the literature on the reactions between cellulose and dilute alkali solutions at higher temperatures, some general points may be considered first, notably the reactivity of cellulose, the solubility of cellulose in alkali, and the solubility of the products of reaction resulting from the action of alkali at higher temperatures on cellulose.

As regards chemical reaction between the cellulose molecule and alkali we can anticipate from the structure of the cellulose macromolecule chemical reactions with the primary and secondary hydroxyl groups in the building unit; and reactions leading to the splitting of linkages which hold the building units together.

One of the main factors governing the reaction of cellulose is, according to H. M. Spurlin (*26*), the rate of diffusion of reagent to the individual hydroxyls of the cellulose in the fibrous state. This, in turn, is governed by the peculiarities of structure of the fiber and the degree of swelling of the cellulose.

It is known that water exerts a certain swelling effect on cellulose, and this effect is enhanced with alkaline solutions. Below a certain percentage of alkali, the penetration into the spaces between individual chains is regarded as very limited unless the crystalline structure of the cellulose has been loosened by some other action (*27*). Thus weak alkali essentially penetrates only into the amorphous regions of cellulose but may react with the surface of the micelles. In order to make all portions of the cellulose fiber available for reaction, the whole structure has to be swollen, before, or during, the reaction. The degree of swelling and thus the reactivity of cellulose will be greatly influenced by the morphology of the fibers.

According to Spurlin, the factors influencing reactivity are as follows:

(1) The presence, or absence ,of other linkages than the 1-4 glucosidic type in the cellulose chain, (2) the chain length distribution, (3) the nature of the end of the chain, and (4) the arrangement of the chains in the solid cellulose structure.

Spurlin also considers that the manner in which a given cellulose reaction proceeds is determined by:

(a) The condition of the cellulose; that is whether the reaction occurs in a homogeneous system, or in a two phase system where the cellulose phase is amorphous, or in a two phase system where the cellulose phase is at least partially crystalline; (b) the solubility of the reaction products in the reaction mixture; (c) the number of reagents that must be available at one point before reaction can occur; and (d) whether the reaction is irreversible, or an equilibrium sets in.

It would, therefore, appear essential to establish to which of the classes cited above belongs the reaction of cellulose with hot weak alkali solutions. Very little precise information is available about this point, but since alkali solubilises cellulose and may accelerate its hydrolysis; and in the presence of air oxidation of cellulose and its degradation products is possible, the chemistry of the reactions involved is very complex. Furthermore, the manner of reaction cannot be a simple one since beside the interaction between caustic soda (water) and solid crystalline and amorphous cellulose some further reactions are possible in the solution between the alkali and dissolved cellulose and dissolved degradation products.

There is, according to E. J. Lorand and A. E. Georgi (*28*) evidence to support the view that cellulose reactions do not follow a single pattern and that the type of reaction varies depending on the reaction partner and its concentration, the reaction medium, temperature, etc. This would mean that the manner of action of hot dilute alkali on cellulose will depend partly on the concentration of alkali and temperature. The matter is further complicated by the different solubility of different chains, that is, the inhomogeneity of cellulose.

The solution of cellulose is almost always preceded by swelling. As mentioned, the reactivity of cellulose is also largely influenced by the degree of

swelling before and during reaction. Since, generally, solubility is dependent on the size of molecules (particles) to be dissolved, it follows that shorter cellulose chains will be more readily soluble than longer ones. The second factor influencing solubility is the morphological structure, that is the relative proportions of crystalline and amorphous regions in the cellulose fibers. Since alkali penetrates more easily into the amorphous regions than into the crystalline and causes swelling, the solubility of the amorphous portion will be enhanced. A further factor appears due to preferential adsorption of alkali by the cellulose with a subsequent decrease in alkali concentration and decreased dissolving power of the solution *(29)*. In addition, Henry's law for solution of cellulose in alkali is not valid, as pointed out by Wo. Ostwald *(30)*. This means that the solubility is dependent on the amount of solid material present; usually it increases with increasing concentration of cellulose reaching a maximum, then it decreases slightly *(31)*. This behavior may be regarded, according to G. F. Davidson *(32)*, as an indication of the heterogeneous character of modified cellulose and may find an explanation by assuming that with increasing amount of solid material for a given volume of solvent, the latter becomes saturated with respect to the longest of the chain molecules that have been dissolving thus the percentage dissolved begins to decrease. It seems, however, questionable whether the classical laws of solubility and equilibrium are directly applicable for solutions of cellulose. Spurlin *(33)* emphasises that methods based on the phase rule have valid application only to cases where a solid, crystalline phase of invariant composition is present.

Finally, the state of cellulose in solution should also be considered and this can be illustrated briefly from Spurlin's treatise as follows: cellulose can be dispersed completely and molecular dispersions are possible in the absence of complicating factors. When associated molecules are present in the solution, they are broken by thermal agitation. Associated molecules (micelles) are supposed to be more stable in concentrated solutions than in dilute. When cellulose is dissolved, there is a possibility of interaction between the solvents and the cellulose (solvation). This solvation can be treated in the same manner as the formation of a new derivative by chemical action would be.

2. The Action of Alkali Solutions at Higher Temperatures on Cellulosic Materials.

(a) Cellulose and Modified Cellulose—Keeping in mind all these points, it appears that the action of hot dilute alkali on cellulose involves a rather complex set of phenomena. It may be anticipated that aqueous alkali at higher temperatures acts as a hydrolysing agent, and, in the presence of air, it may enhance oxidation. It has to be realised, however, that the mechanism of both reactions (hydrolysis and oxidation by air) has not yet been clarified satisfactorily. The alkali solution possesses a certain power to keep some dissolved materials in solution but since in the course of the reaction, the alkalinity decreases, its power to keep the dispersed materials in a dispersed state will obviously be affected.

In the kier-boiling of cotton, hot alkaline solutions are used and the aim is to remove fatty, waxy, and other materials, such as proteins, pectins, etc. During kier-boiling the cellulose may suffer degradation, the extent of which depends upon the conditions applied in kiering. Hot alkaline solutions are also used in making linen fibers suitable for bleaching or other processing. It is intended to remove fats, waxes, and other noncellulosic components and increase the wettability of the fibers.

E. Butterworth and H. A. Elkin *(34)* examined the effect of alkaline hydrolysis on flax fibers by exposing them to the action of dilute boiling sodium hydroxide solution and measuring the loss in weight, change in copper number, viscosity in cuprammonium, and the consumption of alkali. Boiling for a constant period but varying the alkali concentration, they found that the loss in weight rises rapidly with an increase of the initial concentration of alkali while the remaining more resistant part is not completely removed even with a 2% NaOH solution. By assuming that a soluble sodium salt of the noncellulosic component is the main product of the reaction, the weight of sodium hydroxide reacting was calculated, and a definite relationship exhibited between the loss in weight and the alkali used up. This ratio was found —within limitations—to be constant, being found, however, to fall slightly as the initial concentration is increased. These authors point out that the alkali used up in the recation includes all the alkali sorbed, combined, and removed from the solution. It is interesting to note that they calculated the amount of sodium hydroxide absorbed (using the titration curve), and found that the curve expressing the relation between alkali concentration and absorbed quantity shows a maximum and a minimum. The copper number falls with increasing loss in weight and it can be regarded—to a fair degree of accuracy—as a measure of the percentage of noncellulosic component remaining after alkaline hydrolysis. Since, however, the alkali soluble components exhibited reducing properties, the copper number does not afford a direct evidence of chemical degradation of the linen cellulose. The viscosity in cuprammonium first decreased as a portion of alkali soluble material was removed and then rose as a further fraction was removed. The authors point out that the determination of viscosity with the flax fibers investigated is difficult and some corrections were necessary, because an appreciable quantity of the materials was not soluble in the cuprammonium used.

According to H. Rath and C. Kubitzky *(35)* the dissolution of cellulose in alkali is more a peptisation than a true solution. When regenerated cellulose is treated with NaOH, the low molecular constituents diffuse rapidly into the swelling medium while the high molecular, long-chain constituents move more slowly and form a zone of highly viscous gel around the swelling material thus restraining the dissolving process. The addition of hot water coagulates the cellulose in this zone onto the initial material. As in the hot water the solubility decreases momentarily to a minimum, the cellulose from the gel solution precipitates along the original cross-sectional outline. After prolonged treatment the intramolecular forces responsible for this result are overcome by the hydrated ions introduced, and the diffusion process of the swelling particles into the base has progressed so far that no further distinctly visible coagulation is possible. The enlargement of the fibers caused by swelling decreases at the same rate as that at which the dissolving constituents diffuse from the fiber into the base.

W. N. Haworth, S. Peat, and W. J. Wilson *(36)* investigated the loss in weight and the change in copper number of cotton linters and of hydrocelluloses on boiling with water and alkali hydroxide solutions for different periods. (Fibrous and powdery hydro-

cellulose, obtained by mechanical separation of acid treated cotton linters). They found that cotton linters lose weight rapidly at first, then the loss becomes almost constant, although showing with continued boiling a further slight decrease in weight. The loss in weight with time on boiling the hydrocelluloses was somewhat irregular showing a tendency, however, similar to cotton linters, i.e., the loss in weight first increases, then becomes almost constant, or slightly decreases, and finally it increases. The copper number of the hydrocellulose fiber after alkali extraction decreased with continued boiling. They also showed that both the fibrous and powdery hydrocelluloses do not contain acidic hydroxyl groups or uronic acid residues.

G. L. Godman, W. N. Haworth, and S. Peat *(37)* studied also the action of boiling alkali on oxycellulose prepared from cotton linters in cold acid solution by means of potassium permanganate. The fibrous oxycellulose with a high copper number and containing uronic acid residues lost 50% in weight after boiling in a 0.25*N* sodium hydroxide solution. The insoluble residue had a low copper number and contained no acidic groups. It was not homogeneous, i.e., contained chains of different length, thus this insoluble residue is essentially constituted of chain molecules of glucose units united as in the original cellulose molecule, but the average length of these chains is much shorter than that in the original cellulose. An additional extraction of this insoluble residue with 2.5*N* alkali resulted in a liquor from which half of the material dissolved could be recovered by acidification. The fraction soluble in 2.5*N* alkali showed a uniform size of chain molecules but lower than the average of the 0.25*N* insoluble part. Thus this fraction underwent a fragmentation under the influence of 2.5*N* alkali, whereby the longer chain molecules of the 0.25*N* alkali insoluble fraction suffered a shortening. The fraction insoluble in boiling 2.5*N* alkali had as an average a lower degree of polymerization than the material before boiling thus it becomes apparent that the whole of the 0,25*N* alkali insoluble substance has been further degraded by boiling with 2.5*N* sodium hydroxide. By extracting the oxycellulose with barium hydroxide solution it was found that the nature of the products of extraction was unaltered by the exclusion of air during the extraction. Thus, the extraction of oxycellulose with barium hydroxide (3% solution) in air and in nitrogen atmosphere led to the same loss in weight, gave the same weight of mixture of barium salts, and the reducing powers of the extracts were identical. The extracts contained formic, acetic, lactic dihydroxybutyric, and a mixture of saccharic acids. Such acids are also formed when mono- or disaccharides are treated with alkali. They conclude that the fragmentation of the cellulose chain which normally occurs under the action of akali is greatly accelerated if the cellulose is first treated with an acid oxidizing agent. In the oxidation with acid—permanganate, a certain proportion of the terminal primary alcohol groups of the glucose units are converted into carboxyl groups, but it is doubtful if this conversion is the cause of the apparent decreased stability towards alkali of the glycosidic links. (See about this aspect the postulations of G. F. Davidson *(38)*, H. Staudinger and A. W. Sohn *(39)*, and W. O. Kenyon and co-workers *(40, 41)*.

The high reducing power of the oxycellulose suggests—according to these workers—that the fragmentation of the cellulose chain has already occurred during the acid oxidation with a considerable formation of very short chains of glucose units. These short-chain molecules dissolve in boiling with weak alkaline solution and undergo a further degradation, the nature of which is similar to that suffered by reducing sugars when boiled with alkaline solutions.

W. Kaczkowsky, J. Feferman, and S. Zabicky *(42)* found that the curve representing the relation between time and loss in weight of cotton when boiled with alkali rises rapidly at first, then reaching a certain value it remains without change for a relatively long period, and rises again. They explain this rise as the beginning of a new reaction. Since the original of this paper was not available, the results of these workers could not be dealt with in detail.

C. Birtwell, D. A. Clibbens, and A. Geake *(43)* examined the action of boiling 1% sodium hydroxide solution on cotton cellulose modified by acid, i.e., cellulose containing hydrocellulose. They found that the copper number greatly diminished by the alkali boil, but the viscosity in cuprammonium was only slightly changed. A linear relationship was established by them between per cent loss in weight and copper number of the residues of alkaline boiling, up to copper numbers of 2.5. In addition, the alkaline boiled preparations showed a greater solubility in strong cold alkali than before alkaline boiling.

C. Birtwell, D. A. Clibbens, and B. P. Ridge *(44)* prepared two types of oxycellulose, *viz.* the reducing type (high copper number) and the acid type (high methylene blue absorption). The reducing type of oxycellulose, obtained by the action of chlorine water, or acid permanganate solution on cotton, showed a great loss in weight as the result of a boil with dilute alkali while the acid type, obtained by treating cotton cellulose with alkaline hypochlorite or hypobromite, exhibited a high retentive power for alkali. The percentage loss on boiling with dilute alkali and the copper number of oxycellulose follow approximately a straight line irrespective of the oxidizing agent used for preparing the oxycellulose. The acid type of oxycellulose after alkaline boiling lost only very little in weight while the copper number (relatively low in the unboiled oxycellulose) diminished almost to the value of the unmodified cellulose. The reducing type of oxycellulose after the alkali boil was very similar to unmodified cellulose in its properties, (low copper number) the viscosity, however, suffered a further reduction.

D. A. Clibbens, A. Geake, and B. P. Ridge *(45)* found that contrary to pure cotton or acid modified cotton, the viscosity in cuprammonium of cellulose modified by oxidizing agents falls with progressive boiling in dilute alkali. The magnitude of the decrease in viscosity varies with the method by which the oxycellulose has been prepared, but it is very great for neutral hypochlorite oxycelluoses. The copper number decreased with the alkaline boiling; the methylene blue absorption (acid groups) rises still further on alkaline boiling in case of oxy- and hydrocellulose, in spite of a partial removal of acid groups by the alkali.

D. A. Clibbens and B. P. Ridge *(46)* showed that when acid modified cottons were boiled with dilute sodium hydroxide solution, the viscosity was not greatly affected. Oxycelluloses, prepared by the action of acid dichromate solution on cotton, although suffering a great additional loss of strength, showed only a relatively small decrease in viscosity after boiling with dilute alkali.

The high resistance of the acid type of oxycellulose, obtained by the action of alkaline permanganate solution on cotton, was also shown by C. Doree and A. C.

Healey *(47)*. Acid permanganate produces the reducing type of oxycellulose.

G. F. Davidson *(48)* considers the action of hot dilute alkali on hydrocellulose not only as a decomposition and dissolution of the shorter chain molecules but possibly as a shortening of the longer chain molecules as well followed by a decomposition and dissolution of the shorter chained material formed. The observation of the almost unchanged viscosity in cuprammonium after alkali boiling can be explained by a possible counterbalance of two factors, namely, the shortening of the chains decreases the viscosity, while a considerable portion of the shorter chains being removed, the viscosity would increase. Thus, the average chain length (or better the frequency distribution of the individual chain length about the average) determining viscosity, may not be greatly affected by the alkali boil in spite of a considerable loss in weight. He also points out that the action of hot dilute alkali on hydrocellulose is apparently essentially different to that of cold strong alkali since the extracted liquors behave quite differently. Extracting hydrocellulose with hot dilute alkali results in an extract which contains only very little material precipitable by acidification while in the extracts of cold strong caustic soda considerable quantities can be precipitated on acidification.

By boiling dichromate oxycellulose with dilute alkali, the viscosity in cuprammonium drops contrary to unmodified or hydrocelluloses. In such oxycelluloses some alkali sensitive linkages may be present—according to Davidson—which during the boil with alkali lead to a breaking of the chain. This sensitivity or chemical instability appears also when the reducing type of oxycellulose is dissolved in an alkaline solvent such as cuprammonium. Such an effect would evidently disturb any fundamental comparison of viscosity with other characteristics. It is conceivable that oxidation of cellulose does not result directly in a shortening of the chain, but may influence the chemical stability (alkali sensitivity) of the chain molecules.

L. E. Wise *(49)*, and J. T. Marsh and F. C. Wood *(50)* summarized the action of hot dilute alkali on acid modified cellulose as follows: It is most probable that the chain is attacked at the terminal group on account of the loss in reducing power. The reducing group is most likely replaced by a carboxyl group on the evidence of the rise in methylene blue absorption, but the exact nature of the mechanism is not known. It appears to be more than a simple

oxidation from $\begin{array}{l} \\ C \\ H \end{array} = O$ to — COOH.

G. F. Davidson *(51)* suggested that if the viscosity of modified cotton cellulose could be determined without the use of an alkaline medium, a true measure of the average chain length as they exist in the fiber should be obtained. (Nitrocellulose in acetone).

He found by boiling under pressure with sodium hydroxide solution, the relation of cuprammonium viscosity and nitrate viscosity could be expressed by a single curve irrespective of the method of chemical modification of the cellulose and the curve was identical with that for hydrocellulose before alkali boiling. The relation between nitrate viscosity and cuprammonium viscosity differs widely for different methods of chemical modification before alkali boiling of the preparations. Oxycelluloses obtained by the action of acid chlorine or neutral hypochlorite contain alkali sensitive linkages. Such alkali sensitive preparations show a decrease in nitrate viscosity after alkali treatment possibly as the result of a rupture of these linkages. The first step need not take place on the primary alcoholic groups since E. L. Jackson and C. S. Hudson *(52)* showed that periodic acid oxidizes the hydroxyls of carbon atoms 2 and 3 in the glucose unit of cellulose forming a dialdehyde. Because of the dialdehyde formed (rupture of the ring), the ease of hydrolysis of neighboring glucosidic linkages (on carbon atoms 1 and 4) may become more enhanced than by the oxidation of the primary alcoholic group. Such hydrolysis of the glucosidic linkages in the primary oxidation product occurs easily in slightly alkaline medium.

G. F. Davidson *(53)* studied extensively the properties of oxycelluloses obtained by the action of periodic acid on cotton and found that the oxycellulose preparations obtained are of very high alkali sensitivity and of the extreme reducing type. He found that with progressive oxidation by periodic acid the cuprammonium viscosity decreased while the nitrate viscosity changed only slightly. When, however, these oxycelluloses are treated with cold or hot dilute alkalis, the nitrate viscosity decreased considerably. After the alkaline boil, the relation between cuprammonium and nitrate viscosity was the same as for hydrocellulose. He also found that with alkaline boiling the copper number decreases presumably because of a destruction of the aldehyde groups. Since in periodate oxycelluloses, the linkages on carbon 2 and 3 are ruptured, and the adjacent linkages become susceptible to a cleavage by alkalis, he concludes that the alkali sensitivity is not intimately associated with the destruction of reducing groups.

Finally, G. F. Davidson *(54)* showed by determining the loss in weight, yields of formaldehyde, formic acid and carbon dioxide due to oxidation with periodic acid, that the oxidation process is less simple than conversion of the hydroxyls of carbon atoms 2 and 3 into aldehydes. If only such an oxidation took place then the linkages uniting the original glucose units in the chain molecules of cellulose should not be broken by oxidation with periodic acid. The manner in which the oxidized chain-molecule is broken by the action of alkali is still obscure. It seems that the glucosidic linkage attached to carbon atom 4 of the glucose unit that has been oxidized with periodic acid with the formation of a dialdehyde would be susceptible to alkaline hydrolysis. The large loss in weight suffered by periodic acid oxycelluloses under the action of dilute alkalies could also be attributed partly to the presence of alkali sensitive linkages, which will rupture with alkali, but also in part to chemical changes associated with the destruction of reducing groups and similar to those which occur when hydrocelluloses are boiled with alkali. From x ray investigations on periodic acid oxycelluloses, Davidson postulates that the originally crystalline regions are gradually opened up and made accessible to the oxidizing agent. This conclusion is also supported by the great dimensional changes and the enhanced hygroscopicity that result from the oxidation. The opening up of the crystalline regions would render hydrophilic groups more accessible to moisture.

G. F. Davidson *(55)* studied also the properties of oxycelluloses prepared by chromic acid (dichromate in the presence of sulphuric or oxalic acid) and cotton. This type of oxycellulose is highly reducing, nonacidic, and alkali sensitive. He found that with increasing oxygen consumption the oxycelluloses showed a greater loss in weight on treatment with hot dilute alkali solution and increased hygroscopicity

and fluidity in cuprammonium until the oxygen consumption attained a certain value and thereafter they remained almost constant. The methylene blue absorption increased continuously throughout the range of oxidative attack. In the oxidation with chromic acid, carbon dioxide, formic acid, and other soluble and oxidizable products are formed. He suggests that the action of chromic acid is confined largely to the intercrystalline regions.

While Davidson points out that the mechanism of oxidation of cellulose by chromic acid does not follow the same course as the oxidation with periodic acid, Staudinger and Sohn *(56)* have suggested a mechanism that involves the conversion of glucosidic linkages to carbonic ester linkages. By postulating such ester linkages the alkali sensitivity could be explained.

E. C. Yackel and W. O. Kenyon *(57)*, and C. C. Unruh and W. O. Kenyon *(58)* prepared oxycelluloses by means of nitrogen dioxide. The preparations contained a high percentage of carboxyl groups. They found that dry nitrogen dioxide converts preferentially the primary hydroxyl groups of the glucose units into carboxyl groups. The glucosidic linkages do not seem to be affected by the oxidation. The oxycellulose-preparations with higher than 13% carboxyl content were soluble in dilute sodium hydroxide solutions. Since these preparations do not seem to be degraded, their results indicate that the carboxyl groups influence appreciably alkali solubility. The oxycellulose preparations showed a high apparent copper number which they explain by the assumption that the reducing groups are formed during the test, and are not present in the preparations. Under the influence of the alkali, used in the determination of the copper number, the uronic acid chains are hydrolyzed and the aldehyde-groups thus formed reduce the Fehling solution leading to high copper numbers.

SUMMARY

Cellulose.

Boiling with dilute alkaline solutions brings about:

1. A loss in weight, whereby the copper number decreases.
2. The magnitude of loss in weight is closely related to the copper number.
3. The dispersed cellulose and its degradation products in solution seem to be further degraded hydrolytically and by oxidation.
4. The rate of loss in weight on treating cellulose with dilute alkali has not been studied extensively.
5. The mechanism involved is not fully understood; obviously swelling of cellulose and diffusion of alkali play an important role.

Acid Modified Cellulose (Hydrocellulose).

Hot dilute alkali causes:

1. A considerable loss in weight, accompanied with an almost proportional decrease in copper number of the residue, but a simultaneous increase of the methylene blue absorption. Hydrolysis and oxidation of the solid material seem to take place, the latter indicated by the increase of methylene blue absorption.
2. Only a slight decrease in cuprammonium viscosity, possibly as the result of two opposing actions; one shortening the average chain length, the other dissolving the short chains, thus increasing the average chain length.
3. Apparently hydrolysis and oxidation of the dispersed materials take place since reducing sugars and carbonic acids are formed.

Oxycelluloses.

(A) Acid type of oxycellulose.

1. High resistance towards hot alkaline solutions, insofar as the loss in weight is low and seems to be related to the copper number of the preparation.

(B) Reducing type of oxycellulose.

Treatment with hot alkali solutions results in:

1. Large loss in weight, closely related to the copper number.
2. Decrease of copper number almost to the level of that of unmodified cellulose.
3. Decrease in viscosity in cuprammonium.
4. Increase in methylene blue absorption, indicative of oxidation of the solid material.
5. Further degradation and oxidation of the dispersed materials in solution, accompanied by the formation of reducing sugars and carbonic acids.

The molecular mechanism leading to the degradation of the alkali sensitive, reducing type of oxycellulose is not understood. The postulations advanced are that by oxidation of the terminal primary alcohol groups of the glucose units to carboxyl groups the alkali sensitivity of the glycosidic linkages cannot be explained (Haworth and co-workers), but either the glucosidic linkages of the oxidized glucose units become susceptible to alkaline hydrolysis (Davidson), or ester linkages are formed during oxidation, which are hydrolyzed by the alkali (Staudinger and Sohn).

The average chain length cannot be estimated by measuring the viscosity in cuprammonium of alkali sensitive oxycelluloses, due to the alkalinity of this solvent. (Davidson.) It may be estimated by measuring the viscosity of the derived nitrate in acetone.

(C) Extreme reducing type of oxycellulose. (Periodic acid oxycellulose.)

1. Extreme sensitivity towards weak alkalies, possibly due to hydrolysis of glycosidic linkages neighboring to the aldehydes on carbon atoms 2 and 3 (produced by periodic acid), but the exact nature and mechanism is not known (Davidson).
2. The shortening of the chains occurs only after oxidation by periodic acid with a subsequent alkali treatment (Davidson).
3. The copper number decreases with alkali treatment, presumably due to destruction of the aldehyde groups (Davidson).

(D) Extreme acid type of oxycellulose (Nitrogen dioxide oxycellulose).

This type of oxycellulose is soluble in dilute alkali, and since it is not degraded it is indicative that the carboxyl groups formed by the action of nitrogen dioxide brings about the alkali solubility.

(b) *Pulps, Bleached and Unbleached.*—The action of weak alkaline solutions at higher temperatures on cellulosic materials, free of lignin, or containing only small quantities of this substance has been studied by several investigators. The published work reveals however that mainly empirical or intuitive lines were followed. Work devoted to fundamental studies of the rate of removal of hemicellulosic materials, as well as the main reactions upon which the removal depends, is not very extensive.

C. G. Schwalbe and E. Becker *(59)* investigated the action of lime on cellulose fibers (oxy- and hydrocelluloses and wood pulps) by studying the changes in the reducing power of the residual fibers. They found that the hydro- and oxycellulose preparations on boiling with lime result in materials of low copper number falling close to those given for pure cellulose. The reaction is essentially the same as that between simple sugars and lime wherein saccharic acid is formed. Sulphite pulps when boiled with lime lose upward of 50% of their pentosan content and the reducing power is considerably decreased. The residues, however, still contain some pentosan which is very firmly bound. Wood cellulose from soda pulp on boiling with lime yields but a relatively small amount of soluble substance since the cellulose dextrins originally present are previously removed by the soda.

G. P. Genberg *(60)* studied the increase in alpha cellulose content and the total loss of weight by digesting sulphite pulp with lime—and with caustic soda solutions at temperatures of 100 to 140°C. According to him, the loss in weight and the increase in alpha cellulose content are dependent upon the alpha cellulose content of the original pulp. He also points out that a prebleached pulp is more suitable for the hot alkaline refining than an unbleached material; sulphate pulps are not affected to any extent by either lime or caustic soda solution under the conditions applied to sulphite pulp in the investigation.

J. H. Ross and C. R. Mitchell *(61)* extracted partially bleached sulphite pulp with 1, 3, 5, and 7% sodium hydroxide solutions heated to 170°C. for 3 hours. They estimated the alpha cellulose content of the refined pulps, the loss in weight when the extracted samples were boiled with 1% caustic soda solution, and the alpha cellulose content of the residues. They concluded that the resistance to boiling 1% sodium hydroxide solution is not a true indication of the behavior of a pulp toward mercerizing alkali.

The same authors *(62)* treated bleached sulphite pulp with alkali at higher temperatures (150 to 180°C.), applying 1 to 7% NaOH on the weight of pulp, and found that at temperatures below 160°C. the alkali has but little effect on the quantity of materials dissolved and on the alpha- and beta-cellulose contents of the residue. At higher temperatures the effect of concentration is much more marked. For every temperature they found an optimum concen-

tration of alkali which produced a residue of maximum alkali resistance.

H. F. Lewis *(63)* followed the per cent material dissolved with time and the change in some physical and chemical characteristics on five cotton and two wood pulp samples by boiling them with 1, 10, 20, and 30% sodium hydroxide solutions at a relatively high solid-liquid ratio, namely 8 gram of sample and 150 ml. of the relevant solution.

The per cent dissolved material increased with time at first, in case of the cotton samples, then approached constancy although still showing a tendency to decrease. The quantity of dissolved material increased with time, in case of the wood pulps, then it decreased smoothly. (The pulps used had a relatively high alpha content, but contained 4.85 and 5.10% pentosans respectively.) The 20% caustic soda solution in all cases dissolved more material than the other three caustic soda solutions during the same period of treatment. The percentage removal was much higher with the wood pulps than with the cotton samples. Lewis postulates that this greater removal cannot entirely be ascribed to pentosan removal but to an inherent difference in the stability of the cellulose itself. In following the change in copper number with time on boiling the preparations with the alkali solutions, he found that with 1 and 10% caustic solutions the copper number increased in the early stages of boiling but diminished with further boiling. Using 20 and 30% sodium hydroxide solutions, the copper number decreased continuously with time of boiling He concludes that there is an indication of the formation of compounds with high reducing power because of the treatment of the wood pulps with dilute alkali. These reducing compounds however are apparently oxidized further to alkali soluble compounds or are themselves slowly soluble in the alkaline solution. He postulates that because of the fact of the increase in copper number by boiling with the alkaline solutions, some impurities may be present in these pulps which are more easily oxidized than the cellulose itself. A comparatively small concentration of such impurities may be present in the rag samples investigated, or a correspondingly greater stability of the rag cellulose toward the oxidizing action of the alkaline solutions can be assumed. Comparative alkaline digestions of the samples with alkaline solutions in air, nitrogen, and oxygen atmosphere showed that the dissolving action of caustic soda solutions on the pulps is in part a function of the oxygen present and in part may be ascribed to peptization. Lewis postulates that with 20% sodium hydroxide solution, the influence of oxygen is less and the dissolution is largely due to peptization of the pulps or their reaction products. He considers the action of the hot alkali is essentially a peptization and oxidation.

Lewis' observations in connection with the change in copper number with time of boiling with the caustic solutions could find an explanation if two consecutive reactions be assumed, namely, the formation of reducing groups and subsequent oxidation with different velocity leading to a maximum copper number. Another explanation may be—as advanced by Lewis—that the rate of formation of the reducing groups is greater than the rate of solubilizing the products containing these reducing groups.

The per cent dissolved material in many cases reached a maximum and then decreased with time of boiling. This would mean at first glance that some materials already in solution reprecipitated on the fibers leading to a diminished removal. These observations may find an explanation in the particular behavior of colloidal solutions such as pentosans and cellulose in alkali. (See about this aspect the relevant chapter D—1.)

L. Rys and A. Bonisch *(64)* pointed out that in the hot alkaline refining process it is very important to have a raw material with sufficient resistance to alkali otherwise an insufficient alpha content will be obtained with a high loss in material. The removal of lignin, preferentially by chlorination (sulphite pulp), has an effect on the increase of the alpha content after extraction with hot alkali. They studied the influence of temperature, alkali concentration of the liquors, stock concentration, time, and of some further factors, such as double extraction, additions of reducing agents and soda ash to the caustic soda solution, etc. They found that higher caustic soda concentration, higher temperature, and longer reaction time result—within limitations—in pulps with higher alpha content but with lower yields. An intensification of the refining process be it through the use of stronger caustic liquor, lengthening of the reaction time, or increasing the temperature is immaterial and results only in a lowering of yield because of strong degradation of the cellulose or in higher alkali solubility of the treated pulp. Sodium sulphide or sulphite as additions to the extracting liquor give better yields and somewhat lower alpha content. This paper does not give analtyical figures on pentosan content of the pulps before and after different hot alkaline treatments.

G. A. Richter *(65)* refers to the importance of the percentage of alkali based on pulp in the hot alkaline refining process. From 1 to 2% sodium hydroxide solution is commonly prescribed, depending upon the degree of refining desired and the history of the fibers to be refined. Usually better yields are obtained at temperatures close to 100°C. although pentosan reduction becomes more marked at temperatures upward of 125°C. (sulphite pulps). Each successive percentage improvement in alpha cellulose in the product is accompanied by a rapidly increasing rate of sacrifice in yield.

The papers by Lindpaintner *(66)*, Rosenberg *(67)*, and Maksimow *(68)* were extensively discussed in the relevant chapters of this review.

In completing this chapter of the review, consideration should be given to work devoted to the hot alkaline treatment of chlorinated pulp usually inserted in the multistage bleaching process of wood pulps. The primary aim in this step of the bleaching is to remove the chlorinated lignin yet undoubtedly some of the very easily removable hemicelluloses are extracted simultaneously under the conditions usually applied.

G. E. Schmidt, B. L. Shera, and T. W. Toovey *(69)* extracted chlorinated sulphite and sulphate pulps with caustic soda at various concentrations, temperatures, and pulp consistencies for different periods. The extracted material was measured by determining the consumption of potassium permanganate of an aliquot portion of the solution surrounding the pulp, under certain conditions ("K-Number"). They also measured the consumption of NaOH during the extraction and the decrease in pH of the liquor, and found with the chlorinated and neutralized kraft pulp that the velocity of the reaction of the caustic soda with the pulp is very rapid at first, then it slows down. They also found that when the caustic consumption became almost constant, the K-Number of the extract (extracted materials) continued to increase and postulated that a secondary reaction con-

tinues independent of the consumption of caustic soda.

In a further paper, G. E. Schmidt *(70)* studied the rate of incrustant removal from chlorinated pulps treated with dilute alkaline solutions at different temperatures. Comparing the rate of incrustant removal at two temperatures (77°F. and 140°F., 1% NaOH, 9% pulp consistency), it was greater at the higher temperature. He postulated that the presence of atmospheric oxygen may have some effect on the accelerated action at the higher temperature.

F. Loeschbrandt *(71)* in his extensive study on the bleaching of sulphate pulp investigated the factors influencing the removal of chlorinated lignin by weak alkaline solutions at moderately high temperatures and the effect on the removal of varying these factors, this is temperature, time, and alkali concentration.

Loeschbrandt's conditions were chosen to remove primarily the chlorinated lignins and some of the colored impurities, but evidently the very easily soluble hemicelluloses went into solution in the extraction with the weak alkali solutions applied. He does not record the quantity of material removed but only the permanganate number of the extracts and of the pulp-residues, expressing in this way the extent of removal of easily removable materials. He found an increased extraction of chlorinated lignins with increasing reaction times at all temperatures investigated. The effect of time on the removal is small below the temperature of 70°C. but becomes more marked above this temperature probably indicating the beginning of a purification process, i.e., removal of hemicelluloses.

He also points out that, in the removal of these materials, diffusion and solubility of the reaction products play an important role. Thus increasing pulp consistency decreases the diffusion of the reaction products on the one hand and limits the solubility (saturation) of them on the other hand. The initial concentration of alkali of course will be greater the higher the pulp consistency if alkali is added in a constant ratio to the weight of pulp. A further point is that some of the chlorinated lignins being acidic in nature consume alkali in the extraction stage. Additional consumption of alkali may be because of a hydrolytic splitting off of chlorine which is more or less firmly bound to the primary reaction products formed in the chlorination stage and cannot be removed completely by washing the chlorinated pulp with water.

The mechanism of the extraction reactions may be explained, according to Loeschbrandt, by considering three extreme views on the relationship between cellulose and substances (or fractions of them) to be dissolved:

1. Changes in the size of the molecule and diffusion processes as causes of solution.—According to this concept, the diffusibility of certain alkali soluble and acid precipitable fractions may be responsible for the extraction if only these substances are considered. The ionization of these alkali soluble, acid precipitable materials is suppressed with decreasing pH, being of "indicator acid" nature, while it is assumed that only the ionized form of them is small enough to be diffusable. Because of association, however, the solubility limits may be exceeded if the pH of the solution decreases to a certain value. If diffusibility is the controlling factor in the extraction then only the temperature coefficient of the rate of diffusion can be responsible for the effect of temperature on the extraction with alkali.

2. Van der Waal's forces. The condition of cellulose as determining factor.—As a consequence of absorption of hydroxyl ions by the cellulose, the negative potential of it increases. The substances to be dissolved take up hydroxyl ions as well and due to reciprocal repulsion of similarly charged substances opposing Van der Waal's cohesion forces, some of the material will be removed by diffusion. Diffusion may be aided also by a simultaneous increase in the size of the pores of cellulose produced by potential changes or swelling.

The change in potential is dependent on temperature, and with increasing temperature generally the quantity of absorbed material (colored materials in the chlorinated pulp) decreases. A change in the membrane potential of cellulose can also be brought about by electrolytes. Electrolytes thus will inhibit the dissolution of substances soluble in weak alkali. Great concentration of electrolytes may even prevent the extraction of alkali soluble, acid precipitable hemicellulosic materials. The observed action of electrolytes may, however, merely result from an effect on the degree of association and hence diffusability of these substances.

As regards the alkali soluble fraction which is not reprecipitated by acid, Loeschbrandt points out the difficulty of determining it precisely. He decides ultimately that the effect of temperature on extraction by weak alkali cannot be explained by a displacement of the absorption equilibrium with temperature.

3. Chemical (covalent) compounds—The third view consists in the assumption of a chemical bond existing between cellulose and the substances to be removed or a fraction of the latter. Thus the process of extraction depends upon decomposing (dissolving) this compound. According to this hypothesis, the rate of decomposing this compound would vary with the pH of the solution. Yet the temperature effect on extraction (being so small) cannot be explained by this conception. It was actually found that considerable quantities of acid precipitable materials were removed at relatively low temperatures after very short periods of extraction. Thus the rate of decomposition of any compound must have been so great that it may be completely disregarded in any consideration of the rate of extraction process under normal conditions.

In the summary, Loeschbrandt emphasises the important role of diffusion in the alkaline extraction process, and postulates that a part of the substance to be dissolved is present on the surface or in the outer layers of the fibers, thus more susceptible to extraction. The remaining, more deeply embedded portion requires a longer time or higher temperature for its passage through the small pores of the fibers. The condition of the substances to be dissolved and that of the cellulose must be considered in explaining the course of the extraction only insofar as diffusability of these substances is concerned. The rate, however, at which this condition begins to be produced may play a role in the final results of the alkali treatment, and this rate is measurable.

SUMMARY

The results and discussions on the action of hot alkali on pulps containing relatively low percentage of lignin, or negligible quantities of this substance as set out in the above section, can be summarized as follows:

1. The rate of removal of constituents (hemicelluloses) has not yet been studied, insofar as no quantitative expression has been advanced for the rate of removal as a function of certain variables.
2. The mechanism of the reactions involved has not been investigated extensively.
3. Factors influencing the removal of hemicellulosic materials, such as caustic concentration, temperature, pulp stock concentration have been studied, but the conclusions drawn from these results are incomplete and can hardly be generalized without considering the time factor.
4. The action of hot alkali on pulps is considered by H. F. Lewis essentially as a peptization and oxidation.

5. The type of the reaction is that which often is termed as a micellar heterogeneous cellulose reaction acting from the surface of the micelles and going inwards to more deeply embedded hemicelluloses by partially destroying the cellulose (Maskimow).
6. Pentosans are converted by the action of alkali at higher temperatures into saccharinic acids, the sodium salts of which are soluble in dilute alkali, by a disproportionation of the aldehydes of depolymerized carbohydrates (Klauditz).
7. The main responsible factor for removing chlorinated lignins (alkali soluble, acid precipitable fraction) by weak alkali at higher temperatures is the diffusability of these substances and their solubility governed by the pH of the surrounding liquor (Loeschbrandt).
The micellar heterogeneous type of reaction, acting from the surface of the micelles and going inwards to more deeply embedded hemicellulose would imply that the hemicellulose is partly found in the micelles and does not consider the amorphous-crystalline relationship, and the hydrolytic degradation of cellulose and hemicellulose chains together.

(c) *Wood.*—This final chapter deals with the reactions between alkali and the constituents of lignified cellulosic materials at higher temperatures. These reactions although of considerable technical importance are not entirely understood and neither their physicochemical mechanism nor rate have yet been clarified satisfactorily.

M. W. Bray *(72)* studied the effect of several variables on pulping spruce wood with alkali and endeavored to derive a formula through which pulp yield and the associated physical and chemical properties, of pulps may be predicted under certain cooking conditions. He found, in accordance with S. Schmidt-Nielsen, *(73)* that the pulping (rate of total material removed) of wood by alkali does not obey the law of a first order reaction. Calculating the velocity coefficient according to the equation of a monomolecular reaction from the yield data it may be observed that the values of the coefficient for any given temperature decrease with increasing total time of digestion. He also found that the decrease of the values of this coefficient is regular and can be expressed by an empirical formula, viz. $K = Ct^{-m}$, where K is the velocity coefficient calculated from yield figures by means of the equation of a first order reaction, C is a constant, t is the time, and $^{-m}$ a constant. Yet this formula was only valid for cases when the yield was higher than 52%. This fact—according to Bray—may indicate a change in the speed of the pulping reaction, or merely that the equation is only approximate within a specified range of reaction and that, consequently, some other type of equation or of equations will be necessary to explain the side reactions that take place. The reaction that predominated during the early stages of pulping is now either less effective (below 52% yield) or is masked by a slower reaction, namely, the removal or hydrolysis of the more stable cellulose. At about the 52% yield point in the pulping process, the reaction velocity decreases markedly. Thus within limits, i.e., for yields about 52% the equation $K = Ct^{-m}$ had validity and served usefully to predict the yield of pulp obtainable for any period of digestion at a given temperature, caustic soda concentration, and wood liquor ratio. From a first order reaction rate equation one obtains

$$K = \frac{1}{t} \log \frac{a}{a-x}$$

where K is the velocity coefficient, t the time, a the concentration of material (percentage wood) at zero time, and x the total material removed during the time. Substituting $K = Ct^{-m}$ we obtain

$$K = c.t^{-m} = \frac{1}{t} \log \frac{a}{a-x}$$

Since from the experimental yield values K can be calculated, plotting K *versus* t on logarithmic paper, m represents the slope of the lines obtained and c the intercept with the K axis. As may be seen, the slope can be calculated for any temperature when the K value for any definite period of digestion has been determined by experiment for that particular temperature provided the yield exceeds 52%. Having determined the value of K by experiment for some definite period of digestion, and having calculated the slope of the logarithmic line (log t *versus* log K), values for the yield of pulp may be calculated for the period of any other cook made at the same temperature and under the same pulping conditions as those of the experiment from which the K value was determined. This statement, however, as pointed out, holds only for the calculation of yields falling above 52%.

Commenting on Bray's empirical equation, it should be recalled that the action of caustic soda on wood involves undoubtedly a large diversity of kinetic phenomena, and according to E. A. Moelwyn-Hughes *(74)* theoretical equations have for such cases only a restricted applicability. As mentioned in an earlier chapter, the reactions of cellulose cannot be confined to a single pattern (Lorand and Georgi *(75)* and less simple will be the type of reaction between alkali and wood, the latter being highly heterogeneous containing several constituents with different chemical structure, homogeneity and morphology, all influencing reactivity. As Bray claims the equation advanced is only valid within limits, and he also points out that some other type of equation will be necessary to characterize the rate of reaction in the pulping. His postulation that during the early stages of cooking the dominating factor is more effective than in the latter stages, or in the latter stages of cooking the reaction is masked by a slower reaction, can find good support in the results of modern studies devoted to the reactivity of cellulose. These postulations become more remarkable when we consider that they were advanced in 1929 when the knowledge of reactivity of high polymeric compounds was less developed than at present.

C. R. Mitchell and F. H. Yorston *(76)* studied also extensively the kinetics of alkaline pulping. They were mainly concerned with the rate of lignin removal in pulping wood with different alkaline liquors. According to these workers, the rate of removal of lignin at any instant is proportional to a quantity of lignin equal to that remaining at that instant less a constant quantity a, at constant alkali concentration. Thus

$$-\frac{d\,Ly}{dt} = c\,(Ly - a)$$

where $\frac{dLy}{dt}$ is the rate of lignin removal, c a constant, Ly the lignin remaining at the instant t, and a a constant lignin quantity not removable at all (or extremely slowly).

The validity of the rate equation advanced was limited.

Since the alkalinity of the cook liquor decreases during pulping a further rate equation was established by these workers assuming that the velocity constant of delignification is proportional to the actual (not the initial) alkali concentration.

$$-\frac{d\,Ly}{dt} = [\mathrm{NaOH}]\ (Ly - a).$$

Again this rate equation had validity within limitations.

Mitchell and Yorston *(77)* point out that in applying this formula, difficulties arise because of the unsatisfactory measure of hydroxyl-ion activity, by titration of the spent liquors containing alkali and

organic compounds of weakly acidic nature, or to an absorption of alkali by the pulp, or by the colloidally dispersed reaction products. It should also be mentioned that Mitchell and Yorkston's basis for postulating a certain quantity of lignin not removable in the cooking, was that presumably a small portion of the lignin in wood is held in the cell wall and it may not be capable of diffusing out, until broken down to small dimensions, e.g., by bleaching. Still these authors seem rather to accept the view that the reaction rate for this residual lignin is very small, bringing the per cent lignin removed—time curve to a constant value of *a*, or at least approximating this value of *a*. A further difficulty emphasized by them is in the analytical determination of lignin in certain pulps. A further interesting point raised by Mitchell and Yorkston is that practically all the lignin in wood is accessible to the reagent and it may be concluded that lignin has a gel structure. Further comments on the rate equations advanced by these Canadian scientists will follow in a forthcoming paper.

G. L. Larocque and O. Maass *(78)* studied the mechanism and kinetics of alkaline pulping. These authors were again mainly concerned with the rate of delignification in pulping wood with alkaline liquors and with the influence of some factors governing the process of purifying cellulose. They found that with spruce wood and aqueous alkali, the rate of delignification was the same irrespective of the size of the sample from wood meals of 0.0005 mm. particle size up to a limiting chip thickness of about 10 mm. Furthermore, the density of the wood had no influence on the delignification other than that which would be expected from the higher original lignin content of the denser wood. Also the presence of moisture in the wood chips was without effect other than that of diluting the liquor, and the addition of wetting agents for facilitating the penetration was without significant effect.

The factors influencing the pulping (delignification) studied by Maass and co-workers were: I. Time of pulping, II. nature of alkali, III. concentration of alkali, IV. absorption of alkali, V. effect of the solvent, and VI. temperature.

As to I. they found that the rate of reaction was of an apparent monomolecular type, having a definite velocity constant for each set of experimental conditions.

As to II, III and IV, they studied: (a) The ionic properties of the alkali, (b) the concentration of the hydroxyl ions, (c) the solubility of the alkali in the solvent used, and (d) the absorption of the alkali at the reaction interface.

They found that the rate of delignification was different with different alkalis of the same molar concentration used under the same experimental conditions. According to these authors, the observed differences in reaction rate must necessarily have depended on some differences in the properties of the alkali ions involved and may have been due to:

(1) Differences in their degree of dissociation, (2) differences in ionic mobility caused by hydration of the ions, (3) differences in the degree of absorption by lignin, on the assumption that absorption of alkali is a necessary prerequisite for reaction, and (4) variation of the chemical affinity which lignin has for different alkalis.

(1) The dissociations of the alkalis used are too much alike, at the temperatures applied in the cooking to account for the marked differences in the rates of delignification observed.

(2) There was a rough analogy between the ionic mobility and the velocity of delignification. Still they consider that diffusion cannot be the main factor governing the reaction velocity since the temperature coefficient of diffusion of aqueous sodium and potassium hydroxide solutions is 1.2 for 10° rise in temperature whereas the observed temperature coefficient is materially greater, namely from 1.7 to 2.7 at 160°.

(3) and (4). Using different alkalis of different strength, calculating the lignin removal for different periods and plotting the residual lignin values logarithmically against time from the slopes of the curves obtained mean values for the velocity constant at different alkali concentrations were calculated. On plotting concentration of alkali against the velocity constant, curves were obtained, the resemblance of which the Freundlich's absorption isotherms suggests that the rate of reaction might depend on the adsorption of alkali at the liquor-lignin interface. The rate of reaction would then depend on the concentration of the adsorbed alkali. Absorption measurements on wood *(79)* showed that there is no proportionality (or only a rough proportionality) between absorption of alkali and velocity constant.

As to V. they explain the influence of the solubility of the alkali in the solvents used (water and alcohols) by the difference of "escaping tendency" of the alkalies in the solvents. The magnitude of "escaping tendency" is a measure of the extent to which the dissolved substance tends to pass off as a gas, to dissolve in a second nonmiscible fluid phase, or to become sorbed on a solid surface. There was a fairly good proportionality noticeable between "escaping tendency" of sodium hydroxide in different solvents and the velocity constant. The greater "escaping tendency" results in a greater adsorption of alkali at the reaction interface and in a correspondingly greater reaction velocity.

Finally as to VI, by applying the theory of Arrhenius for the relation between velocity constant and temperature, they calculated the energy of activation of the delignification reaction.

The final conclusion to which these authors arrived was that the adsorption of alkali at the reaction interface is the determining factor in setting the rate of delignification. A tentative theory for the mechanism of the delignification reaction was also advanced by them (see below).

Commenting on Larocque and Maass' theory, it should be mentioned that some conclusions were drawn on the basis of a reaction of first order for the delignification process. That this reaction is not quite a first order reaction was admitted by them.

SUMMARY

Summarizing the work devoted to the action of alkaline solutions at higher temperatures on lignified cellulosic materials, including the considerations given to the molecular mechanism involved in the process of removing alkali soluble materials, and to the rate with which such materials are removed, we may say that:

1. The rate equations advanced for the total material removed in alkaline pulping are only valid within limits (Bray);
2. the rate equations advanced for delignification by alkaline solutions are also valid with limitations (Mitchell and Yorston);
3. the mechanism involved in the delignification process is regarded as essentially a chemical "combination" between lignin and alkali at the interface followed by a "solution" of the reaction product. It is not known whether they take place simultaneously, or one is slower than the other and governs the reaction (Larocque and Maass);
4. the mechanism involved in removing alkali soluble materials in alkaline pulping is not known, but probably the reaction that predominates during the early stages of pulping with alkali becomes less effective in the later stages of as masked by a slower reaction (Bray).

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Linter Cotton Makes Fine Paper

By William H. Jones[1]

Abstract

First cut cotton linters has been found to be a saisfactory raw material for ray content papers.

A wet lap pulp has been developed that can be added to the beaters without prior processing; its characteristics are given in brief.

One of the lessons that the war has taught has been the importance of adequate sources of raw material. Current scarcities have shown that it is always an advantage to the producer to have as many sources of supply as possible. The large automobile manufacturer, for instance, commonly prefers to have numerous sources of supplies for at least the more important parts of his car.

With the development of Rayco linter cotton (first cut) as a raw material for the paper manufacturer—and particularly for the manufacturer of writing paper—a very important part of the paper industry has gained a new source of raw material. And this gain has been particularly beneficial in that it has not involved anything in the nature of an imitation or a substitute. Paper is made out of cotton fiber and linter cotton is just as truly virgin cotton fiber as that which is used for spinning purposes. It has demonstrated certain exclusive advantages which have given it a definite place in the post-war planning of the makers of fine paper.

The use of first cut linter cotton has been greatly facilitated by the manner in which the suppliers have cooperated with the paper manufacturer. Every bale of linter cotton, of the same grade, is uniform in quality for shipment-after-shipment and reaches the user free from contaminating material. And, most important of all, chemists and technicians are always ready to help each user in working out the particular problems raised by the adaptation of linters to his manufacturing process. This technical assistance has been the greatest single factor in making the use of linters successful even where previous experiments with linter material had not produced entirely satisfactory results. It is to be recognized that each papermaker's production presents individual problems: such problems as how linters lend themselves to hydration in the beater process to yield a pulp of proper consistency, viscosity control, bleaching, sizing, how best to regulate length of cooking time, concentration of caustic used, and the amount of pressure used in the cooker. Chemists and technicians have

[1] Vice President, Railway Supply & Mfg. Co., Cincinnati, Ohio.

gone into the manufacturers' plants and worked with laboratory and production personnel to develop the best procedures for using linters with the individual manufacturer's equipment, to simplify production, and produce his particular type and quality of paper. Results have proven most satisfactory and have demonstrated the value of linter cotton as an additional source of material for boosting production, reducing labor costs, and maintaining uniform quality in the production of fine paper.

Papermakers have been quick to find that one of the distinquishing features of linter cotton is its absolute uniformity. After grading and combining of grades there is uniformity in the bale itself. With linters there are no colors to eliminate, no dyes to wash out; the problem of such contaminating foreign matter as adhesives, cellophane, and synthetics that are impossible to remove even by cooking and bleaching, thus giving untold trouble to the papermaker is absent.

The fiber does not require sorting thus bringing a big saving in labor cost and it can be charged in large quantities in the cooker instead of having to be broken up into fine pieces.

In making tests, cooking time for linters has been reduced to 4 hours. In some cases, depending upon the grade of stock desired, it may be possible to get this cooking time down to 2 hours. There are no knots or weaving to beat out of linters.

Wet Lap Pulp

Realizing that lack of sufficient cooker capacity was causing difficulty in keeping the papermaking machines in many plants operating to capacity, linter cotton was developed in wet lap form as an emergency measure. This pulp is shipped to the paper manufacturer ready for his beaters. It requires no sorting, cleaning, bleaching, or cooking. The wet lap pulp effects valuable savings of time and labor by eliminating many previously essential manufacturing steps in the paper mill. Users say that it has been of invaluable assistance in enabling them to maintain high production even in these difficult days.

Shown below are some of the actual physical and chemical characteristics determined for this pulp from tests obtained from composite sample taken from many cooks representing over 150 tons:

Alpha cellulose, %	98.3
Viscosity, cp.	325
Copper number, %	0.2
Ash, %	0.2
Brightness	80.6

All chemical values are reported on a moisture-free basis.

Viscosity value is TAPPI cuprammonium viscosity obtained from a correlation curve between TAPPI and cupriethylenediamine.

Alpha cellulose as determined by TAPPI Standard Method T 203 m-40.

Copper number was determined by TAPPI Standard Method T 215 m-42.

Brightness was obtained on a Photovolt Meter and translated into General Electric brightness units by use of a correlation curve made between the two instruments.

The freeness of this pulp runs about 880 to 890 using a Schopper Riegler freeness tester under standard conditions (2 grams moisture-free stock diluted to 1 liter at a temperature of 25° C.) The pulp as it leaves the bleach plant is somewhat freer than this.

It is true that to manufacture satisfactory pulp every precaution should be taken to maintain maximum strength and at the same time obtain high color. A strict control system plays a big part in the proper manufacture of good pulp from linter cotton. It has been found in manufacturing this pulp that the viscosity tests must be rapid and frequent. For this purpose the cupriethylenediamine test is used, and a set-up is maintained by which the laboratory can report the viscosity of the pulp 20 minutes after they receive the wet sample as compared to the old cuprammonium test which required over-night agitation to put the sample into solution. With this improved method the viscosity of the pulp is followed during the processing.

The minimum specification for viscosity established for linters pulp is 200 cp. in TAPPI units. The minimum of 200 cp. was selected because it has been found that, in general, values above this for the pulp give very little if any added strength to the paper made from that pulp. Of course, if the viscosity drops below 200 cp., the drop in sheet strength, in particular, fold, is immediately obvious.

Post-War Future

As for the post-war future of linters in writing paper manufacture, it is expected that linter cotton will take its permanent place among the papermakers' standard sources of raw material. A supply of linters will be available for as long as cotton is grown. The problems incident to the use of linters are constantly diminishing as the paper industry's experience with linters increases.

TAPPI Notes

The TAPPI Maine-New Hampshire Section will meet at Orono, Maine on October 26-27, 1945. On Friday morning, October 26th, there will be visits to local mills. In the afternoon technical papers will be presented and in the evening there will be a banquet at which time the Section will receive its charter from the National Association. On Saturday morning a symposium on instrumentation in the paper industry will be presented and in the afternoon there will be a football game between the University of Maine and the Massachusetts State College. E. J. Lamb of the Oxford Paper Company is chairman of the program committee and Clifford Patch of the Eastern Corporation is chairman of the Section.

Joseph S. Illick has been named Dean of the New York State College of Forestry, Syracuse, N. Y.

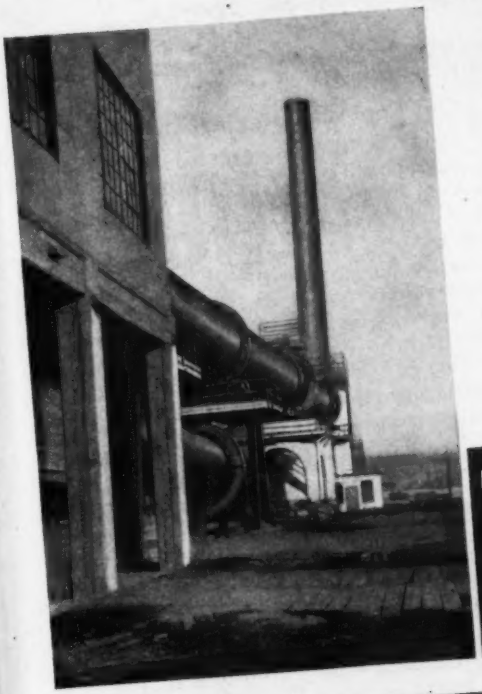
The Chicago Professional Paper Group met at the Chicago Bar Association, 29 So. La Salle Street, Chicago on Monday, September 24th at 6:30 p. m. The speaker was Otto Kress, Technical Director of the Institute of Paper Chemistry, Appleton, Wis., who spoke on Paper Making for the Armed Forces in Continental Europe in 1945.

Lt. Vernon L. Tipka, formerly of the Hawley Pulp & Paper Company is now attached to the Jersey City Quartermaster Depot.

Allen Joins U.B.C.

VANCOUVER, B. C., September 17, 1945—George S. Allen, Ph.D. has become associate professor of forestry at the University of British Columbia, resigning from the B. C. Forest Service. Dr. Allen will teach silviculture. He has been engaged while with the forest service in growth and yield studies and has devoted particular attention to the study of Douglas fir from seed germination to maturity.

PAPER MILL OPERATORS



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Are you 100% sure, for example, that no felt exists which could perform better on your machine? Simple changes sometimes lead to startling results.

One mill changed specifications and increased felt life 20%. Another added 8% to machine speed. Still another licked a baffling pin hole problem in their sheet. Why not be sure in your case? THE ORR FELT & BLANKET CO., Piqua, Ohio.

ORR FELTS

New York Paper and Pulp Market Review

Termination of Paper Order L-120 On September 30 Increases Confidence of Return To Normalcy — Pulpwood Needs Continue At 16,000,000 Cord Rate — Wood Pulp Output Below Average.

Office of the PAPER TRADE JOURNAL,
Wednesday, September 26, 1945.

With the revocation of Order L-120, effective September 30, the wholesale paper market is reflecting increasing confidence of a more rapid return to normalcy. The end of this general limitation order on paper and paperboard removes control of weight, size, packaging, color and all wartime limitations in the manufacture of paper. This revokes, of course, the simplification and standardization order, with sixteen schedules, covering practically all types of paper and converted paper products, except wrapping paper.

The index of general business activity for the week ended September 15 rose to 125.9, from 123.4 in the preceding week, compared with 137.1 for the corresponding week in 1944. The index of paperboard production was 147.5, compared with 139.2 for the previous week, and with 145.5 for the corresponding week in 1944.

Paper production for the week ended September 15 was estimated at 94.0%, compared with 92.8% for 1944, with 92.2% for 1943, with 85.2% for 1942, and with 103.8% for 1941.

Paperboard production for the week ended September 15 was 93.0%, compared with 97.0% for 1944, with 98.0% for 1943, with 81.0% for 1942, and with 99.0% for the corresponding week in 1941.

Pulpwood

With the cancellation of Order M, 251, all controls on pulpwood were removed. Arrangements made with the Canadian Timber Control and War Production Board covering shipments of 1,800,000 cords of pulpwood to the U. S. during 1945, will be continued on a voluntary basis through January, 1946. The reconversion needs for paper will probably require a high level of domestic supplies, at the rate of about 16,000,000 cords annually.

Wood Pulp

Wood pulp production by U. S. mills declined 49,000 tons below the three quarterly monthly average of 862,000 tons in July, the Department of Commerce reports. Estimates of all-over fourth quarter supplies include 2,631,000 tons of domestic, 278,000 tons of Canadian pulp, and 250,000 tons of Swedish origin.

The largest increases in production in 1945 thus far have been as follows: bleached sulphate 14.7%; alpha and dissolving grades, 12.6%, and miscellaneous, 14.7%. Output of unbleached sulphite declined 1.8%. The total supply rose 4.1% during the three-quarter period.

Rags

Demand is currently reported active for almost all grades of cotton cuttings. Mill buying continues relatively heavy in the paper-making grades with continuing emphasis on standard practice in sorting and packing. Prices are firm at ceiling levels.

Roofing felt mills continue to absorb a relatively large volume of old cotton rags. Demand for old whites and blues is heavy. Supplies are reported moderately large but in the above grades demand is reported in some quarters as above supplies at this date. Prices are firm at ceiling levels.

Old Rope and Bagging

Resale of new rope is still governed by Order M-84, and paragraph (d) (1) permits use of new rope and twine only as listed in Schedules A for rope and Schedule B for twine in the M-84 order.

Mill purchasing of scrap bagging continues in much the limited, cautious manner of past weeks. A somewhat larger volume is indicated in some reports received this week. The activity in this grade is reported as fair to moderate, with the market rather limited and lacking any substantial automotive orders. Prices are unchanged. Government buying plans in burlap will end on December 31, 1945.

Old Waste Paper

U. S. receipts of waste paper for July totaled 619,000 tons, compared with 673,000 tons in June, and with 674,000 tons in July, 1944. Total for the first 7 months of 1945 was 4,656,000 tons, compared with 4,850,000 tons in the like period in 1944, a decline in 1945 of 4.0%.

Collections in the New York area totaled 63,080 tons in August, compared with 59,746 tons in July, and with 68,266 tons in August, 1944.

Mill Suppliers Meet

The first fall meeting of the New York Association of Dealers in Paper Mills Supplies, Inc., was held September 20 at the Hotel Brevoort, New York, and was largely attended. Gus R. Holm, of the Derrico Company, Inc., president of the association, presided.

Guests at the meeting were Walter J. Merrill, of the Publishers Association of New York, who is in charge of the continuance of the newspaper waste paper salvage campaign locally now that the national committee has withdrawn from the scene, and Alex B. Johnson, associate executive secretary of the New York Regional Salvage Division of the War Production Board.

Harris Goldman reported for the good and welfare committee, Walter H. Martens for the transportation committee, Anthony Nicoletti on wiping rags, Louis Marcovitz for the membership committee, Edward J. Keller for the foreign trade committee, and Paul J. White and James T. Flannery for the special waste paper committee.

Mr. Flannery reported it is probable the OPA will shortly issue another amendment to the Waste Paper Maximum Price Order No. 30 which will clarify definitions on kraft paper and book stock.

A nominating committee of three, consisting of Walter H. Martens, Joseph P. Gaccione and Arthur Uhrbach, was appointed by president Holm to bring in a slate of nominees for officers and Executive Committeemen of the Association at the next meeting.

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The high tinting strength of PARIS 2 Black means less pigment to secure a desired shade. This together with exceedingly small particle size contributes to unimpaired strength in the finished stock. Other desirable characteristics are:

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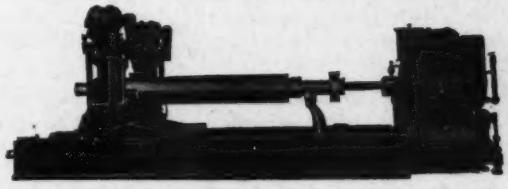

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If your mill requires enough roll grinding to utilize profitably your own grinder, it's good business to invest in a Lobdell—the *completely* automatic Roll Grinder—with patented automatic crowning device.

The addition of the new, automatic grinding wheel in-feed makes precision grinding certain.

A half turn of a knurled knob gives continuous wheel pressure on the roll. Regardless of the type of paper to be made, the Lobdell Grinder will do a better, faster job.

Made in three sizes, there is a Lobdell to meet your requirements. Our engineering consultation is always available.

Catalog with detailed information on our entire line will be sent upon request. Write for it today . . . on your letterhead, please.

SEND IN YOUR ORDER . . . PROMPTLY— The anticipated demand for new equipment will tax our production schedule. Do not put off ordering . . . avoid delay in delivery.

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COMPANY — *Established 1836*
Built and sustained upon the right to FREE COMPETITIVE PRIVATE ENTERPRISE guaranteed by the Constitution of the United States
WILMINGTON 99, DEL.

MISCELLANEOUS MARKETS

Office of the PAPER TRADE JOURNAL,
Wednesday, September 26, 1945.

BLANC FIXE—Prices on blanc fixe continue unchanged at prevailing levels. Demand is reported fair. The pulp is quoted at $40 per ton, in barrels, at works. The powder is quoted at $60 per ton, f.o.b. works.

BLEACHING POWDER—All-over demand continues heavy. Production reported high. Backlog orders still very large. Quotations are unchanged. Bleaching powder is currently quoted at from $2.50 to $3.10 per 100 pounds. All prices in drums, car lots, f.o.b. works.

CASEIN—OPA maximum prices on processed acid-precipitated casein are as follows: 10,000 pounds or more 24 cents per pound; 2,000 pounds, 24½ cents per pound, less than 2,000 pounds, 24¾ cents per pound f.o.b. shipping point. Imported 21 to 23 cents.

CAUSTIC SODA—Demand very heavy. Production large, but under demand. Market tight. Shipments a little delayed by lack of manpower. Solid caustic soda is currently quoted at $2.30 per 100 pounds. The flake and ground are currently quoted at $2.70 per 100 pounds. All prices in drums, car lots, f.o.b. works.

CHINA CLAY—Current demand is reported moderate on many grades of china clay. Quotations unchanged. Domestic filler clay is quoted at from $7.50 to $15 per ton; coating clay is quoted at from $12 to $22 per ton, at mines. Imported china clay is currently quoted at from $13 to $25 per long ton, ship side.

CHLORINE—Military and all essential requirements heavy. Output continued at good level. Paper allocated 46,284 tons. Chlorine is currently quoted at $1.75 per 100 pounds, in single unit tank cars, f.o.b. works.

ROSIN—Offerings and sales light. The OPA price on "G" gum rosin is $6.74 per 100 pounds in barrels, at Savannah. "FF" rosin is established quoted at $6.70 per 100 pounds, in barrels at New York. Average price on seventy per cent gum rosin size is $6.95 per 100 pounds, f.o.b. works.

SALT CAKE—Prices on salt cake continue to be reported unchanged. Domestic salt cake is currently quoted at $15 per ton, in bulk. Chrome cake is currently quoted at $16 per ton. All quoted prices in car lots, f.o.b. shipping point.

SODA ASH—Heavy demand for soda ash is reported to absorb current production. Market still is tight. Prices continue to conform to prevailing levels. Quotations on soda ash in car lots, per 100 pounds, are as follows: in bulk, $.90; in paper bags, $1.05; and in barrels, $1.35.

STARCH—Corn market is reported steady. Offerings moderate at this date. Demand heavy. Prices unchanged on starch. Pearl is quoted at $3.72 per 100 pounds. Powdered starch is quoted at $3.83 per 100 pounds. All prices in bags, car lots, f.o.b. Chhicago.

SULPHATE OF ALUMINA—Demand good. Supply situation is favorable. Prices of the commercial grades are currently quoted at from $1.15 to $1.25 per 100 pounds. The iron free is currently quoted at $1.75 per 100 pounds. All prices in bags, car lots, f.o.b. works.

SULPHUR—Current consumption of sulphur continues heavy. Market situation unchanged. The quotation on Annual contracts continues at $16 per long ton, f.o.b. mines. The current price on contracts at Gulf Ports is $17.50 per long ton.

TALC—Demand reported good. Domestic grades are currently quoted at from $16 to $21 per ton at mines. Canadian at $24 per ton. All prices in car lots.

MARKET QUOTATIONS

All market quotations, excepting those otherwise designated as official OPA maximum prices, are based on the manufacturers' price level as of October 1-15, 1941; maximum wholesale prices are based on the merchants' maximum prices for stipulated quantities at a quoted price to all customers of a like class, as shown by the merchant's sales records of goods delivered during March, 1942. A merchant's price list in effect in March 1942, showing quotations of actual shipments, will establish the current maximum prices.

Paper

(Delivered New York)

Standard News, per ton—			
Roll, contract	*$61.00	@	—
Sheets	69.00	@	—
* OPA Maximum Price.			
Kraft—per cwt.—Carload Quantities Zone A, Delivered			
Superstandard Wrapping	*$5.25	@	—
No. 1 Wrapping	*5.00	"	—
Standard Wrapping	*4.75	"	—
Standard Bag	*4.375	"	—
* OPA Manufacturers' Prices.			
Tissues—Per Ream—Carlots			
White No. 1	1.12½	"	—
White No. 1 M. G	1.10	"	—
White No. 1½	1.00	"	—
White No. 2	.90	"	—
Anti-Tarnish M.F.	1.20	"	—
Colored	—	"	—
Kraft	.95	"	—
Manila	.90	"	—
Toilet—1 M. Sheets—Per Case			
Unbleached	4.25	"	—
Bleached	5.70	"	—
Unbl. Toilet, 1 M.	4.16	"	—
Bleached Toilet	5.70	"	—
Paper Towels, Per Case—			
Unbleached, Jr.	2.20	"	—
Bleached, Jr.	3.20	"	—
Manila—per cwt.—C. l. f. a.			
No. 1 Jute	11.25	@	—
No. 1 Manila Wrapping, 35 lb.	6.00	"	6.25
No. 2 Manila Wrapping, 35 lb.	5.75	"	6.00
Boards, per ton—			
News	*$50.00	@	—
Chip	*50.00	"	—
Sgl. Mla. Li. Chip	*62.00	"	—
White Pat. Coated	*75.00	"	—
Kraft Liners 50 lb.	*63.00	"	—
Binders Boards	84.00	"	116.00

* OPA Base Prices per 10 tons. Less than 10 tons but over 3 tons, add $2.50; three tons or less, add $5. regular 35-39 basis, add $5.; basis 40-49, add $2.50; basis 91-100, add $2.50; basis 101-120, add $5.

The following are representative of distributors' resale prices:

Rag Content Bonds and Ledgers—White, Assorted Items. Delivered in Zone 1:

	Bonds	Ledgers
100% Rag Ext. No. 1	$39.10@$46.00	$40.25@$47.25
100% Rag	32.20 " 37.75	33.35 " 39.25
85% Rag	" "	29.90 " 35.00
75% Rag	23.00 " 27.00	24.15 " 28.25
65% Rag	.... "	22.80 " 27.75
50% Rag	18.70 " 22.75	19.90 " 24.25
25% Rag	16.40 " 20.00	17.55 " 21.50

Colors at $1.00 cwt. extra.

Sulphite Bonds and Ledgers—White, Assorted Items. Delivered in Zone 1:

	Bonds	Ledgers
No. 1	$10.55@$12.75	$11.70@$14.25
No. 2	9.65 " 11.75	10.80 " 13.25
No. 3	9.20 " 11.25	10.35 " 12.50
No. 4	8.90 " 10.75	10.05 " 12.25

Colors $1.00 cwt. extra.

Free Sheet Book Papers—White, Cased Papers. Delivered in Zone 1:

No. 1 Glossy Coated	$13.65	@	$13.90
No. 2 Glossy Coated	12.40	"	14.00
No. 3 Glossy Coated	11.60	"	13.25
No. 4 Glossy Coated	11.15	"	12.75
No. 1 Antique (watermarked)	10.25	"	11.75
No. 2 Offset	9.60	"	11.00
A Grade E. F.	9.35	"	10.75
A Grade S. & S. C.	9.60	"	11.00
B Grade E. F.	8.85	"	10.25
B Grade S. C.	9.10	"	10.50
C Grade E. F.	8.55	"	9.75
C Grade S. C.	8.80	"	10.00
D Grade E. F.	8.25	"	9.50
D Grade S. & S. C.	8.50	"	9.75

Ivory & India at $.50 cwt. extra.

Wood Pulp

OPA Maximum Prices and Canadian Manufacturers Prices, Less Freight Not Exceeding OPA Allowances.

Bl. Softwood Sulphite	$86.00
Unbl. Softwood Sulphite	74.00
Bl. Hardwood Sulphite	83.50
Unbl. Hardwood Sulphite	71.50
Bl. Mitscherlich	81.00
Unbl. Mitscherlich	72.00 @ 82.00
N. Bleached Sulphate	86.00
S. Bleached Sulphate	79.00
N. Semi-Bleached Sulphate	82.00
S. Semi Bleached Sulphate	75.00
N Unbl. Sulphate	73.00
S Unbl. Sulphate	63.50
Bl. Soda	76.00
Unbl. Soda	72.00
Groundwood	50.00

Transportation Allowances

Applying to Producers of Wet Wood Pulp.

	Below 50% Air Dry Weight
Northeast	$13.50
Lake Central	13.50
Southern	16.00
West Coast (in area)	10.50
West Coast (out area)	16.50

	50% 80% Air Dry Weight
Northeast	11.50
Lake Central	11.50
Southern	14.00
West Coast (in area)	9.50
West Coast (out area)	15.50

Applying to Producers of Dry Wood Pulp.

	Above 80% Air Dry Weight
Northeast	$8.50
Lake Central	8.50
Southern	11.00
West Coast (in area)	7.50
West Coast (out area)	13.50

Should freight charges actually exceed these allowances, the difference may be added to the maximum prices.

Domestic Rags

New Rags

(Prices to Mill f. o. b. N. Y.)

Shirt Cuttings—			
New White, No. 1	6.50	@	7.25*
Silesias No. 1	—	"	5.75*
New Unbleached	6.75	"	7.50
Blue Overall	—	"	5.50*
Fancy	—	"	3.50*
Washables	—	"	1.00*
Bleached Khaki Cuttings	—	"	4.25*
Unbleached Khaki Cuttings	—	"	5.50*

*OPA Maximum Prices

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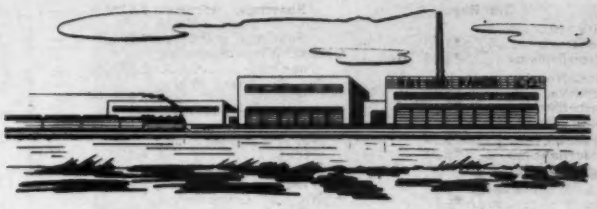
WATER FILTERS AND PAPER FINISHING MACHINERY



The history of the Norwood Engineering Company is virtually a story of the growth of the papermaking industry in this country. Norwood Water Filters, Calenders and Paper Finishing Machines have pioneered the way through the years. The same high type of engineering skill that designed the original models has improved and enlarged the line continuously. The Norwood Filters and Calenders of today are truly tomorrow's promise fulfilled.

Write us freely about your plans for postwar construction, or equipment modernization. Our Norwood engineers offer you the benefit of their long experience with papermaking and paper-converting problems. P-1

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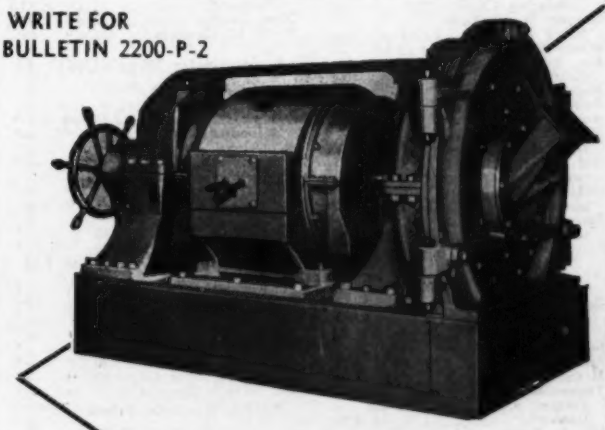

For refining kraft, sulphite, and soda fully cooked chemical pulp, rag and other half stocks.

★ *A Better Product*
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LOWER COST OPERATION

Type 36-2 Rotary Disc

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Interchangeable plates permit use on fine screen rejects, on Kraft, soda, sulphite knotter, hogged-bull and raw ground-wood rejects, semi-chemical chips, bagasse, straw, de-inked stock.

★ Versatile
Operates over a wide range of consistencies. Good results have been obtained up to 8% and even more.

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Manufacturing Engineers Since 1866

24 Waldron Street • Muncy, Pennsylvania

Old Rags

White, No. 1—			
Repacked	*3.80	"	—
Miscellaneous	*3.20	"	—
White, No. 2—			
Repacked	*2.90	"	—
Miscellaneous	*2.65	"	—
Thirds and Blues—			
Repacked	*2.20	"	—
Miscellaneous	*1.30	"	—
Roofing Rags—			
No. 1	*1.55	"	—
No. 2	*1.45	"	—
No. 3 (bagging)	*1.35	"	—
No. 4	*1.35	"	—
No. 5A	*1.35	"	—
Old Manila Rope	5.75	"	—

* OPA Maximum Prices.

Foreign Rags

Pre-War Quotations
All Prices Nominal

New Rags

New Dark Cuttings	2.25	@	2.40
New Mixed Cuttings	2.00	"	2.20
New Light Silesias	5.50	"	5.75
Light Flannelettes	5.50	"	5.75
New White Cuttings	7.00	"	7.50
New Light Oxfords	4.00	"	4.50
New Light Prints	3.00	"	3.25

Old Rags

No. 1 White Linens	7.50	"	8.50
No. 2 White Linens	6.50	"	7.50
No. 3 White Linens	4.50	"	—
No. 4 White Linens	2.25	"	3.25
No. 1 White Cotton	4.25	"	4.75
No. 2 White Cotton	3.25	"	3.75
No. 3 White Cotton	2.50	"	3.00
No. 4 White Cotton	1.90	"	2.20
Extra Light Prints	2.00	"	2.40
Ord. Light Prints	1.75	"	2.15
Med. Light Prints	1.55	"	1.95
Dutch Blue Cottons	2.25	"	2.50
French Blue Linens	3.00	"	—
Checks and Blues	2.00	"	—
Linsey Garments	1.90	"	2.00
Dark Cottons	1.50	"	1.60
Old Shopperies	1.30	"	1.45
New Shopperies	1.45	"	1.50
French Blues	2.25	"	2.50

BAGGING

(Prices to Mill, f. o. b. N. Y.)

Gunny No. 1—			
Foreign	Nominal		
Domestic	3.25	@	3.30
Wool Tares, light	3.25	"	3.50
Wool Tares, heavy	3.50	"	3.75
Bright Bagging	3.25	"	3.50
Manila Rope—			
Foreign	—	"	—
Domestic	*5.75	"	—
Jute Threads	5.50	"	—
No. 1 Sisal Strings	*4.00	"	—
Mixed Strings	2.00	"	—

* OPA Maximum Prices.

Old Waste Papers

(F. o. b. New York)

OPA Maximum Prices, Baled

No. 1 Hard White Envelope Cuts, one cut	3.37½	@	—
No. 1 Hard White Envelope Cuts	3.12½	"	—
No. 1 Hard White Shavings, unruled	2.87½	"	—
No. 1 Hard White Shavings, ruled	2.50	"	—
Soft White Shavings, one cut	2.87½	"	—
No. 1 Soft White Shavings	2.50	"	—
Soft White Shavings, Misc.	2.15	"	—
No. 1 Fly Leaf Shavings	1.67½	"	—
No. 2 Fly Leaf Shavings	1.12½	"	—
No. 1 Groundwood Fly Leaf Shavings	1.25	"	—
No. 2 Mixed Groundwood Fly Leaf Shavings	.90	"	—
Mixed Colored Shavings	.75	"	—
Mixed Groundwood Colored Shavings	.90	"	—
Overissue Magazines	1.67½	"	—
No. 1 Heavy Books & Magazines	1.92½	"	—
Mixed Books	1.10	"	—
No. 1 White Ledger	2.30	"	—
No. 2 Mixed Ledger, colored	2.00	"	—
New Manila Envelope Cuttings, one cut	2.87½	"	—
New Manila Envelope Cuttings	2.65	"	—
Extra Manilas	1.95	"	—
Mixed Kraft, Env. & Bag Cuttings	2.75	"	—
Kraft Envelope Cuttings	3.25	"	—
Triple Sorted, No. 1 Brown Soft Kraft	2.50	"	—
New 100% Kraft Corrugated Cuttings	2.25	"	—
No. 1 Assorted Old Kraft	1.75	"	—
New Jute Corrugated Cuttings	.90	"	—
Old 100% Kraft Corrugated Containers	1.75	"	—
Old Corrugated Containers	1.40	"	—
Box Board Cuttings	.72½	"	—
White Blank News	1.65	"	—
Overissue News	1.10	"	—
No. 1 News	1.00	"	—
No. 1 Mixed Paper	.95	"	—
Old Corrugated Containers	.82½	"	—
Mill Wrappers	1.10	"	—

Twines

All Prices Nominal
(F. o. b. Mill)

(Soft Fiber)

Coarse Polished—			
India	.21	@	—
White Hemp	.21	"	—
Fine Polished—			
Fine India	.26	"	—
Unpolished—			
Box	.17¾	"	—
Paper Makers	.17	"	—
Tube Rope	.19	"	—
Wall Paper	.20½	"	—
Wrapping	.23	"	—
Soft Fiber Rope	.19	"	—
Cotton	.25	"	—

(Hard Fiber)

Medium Java	.18	"	—
Mex. Sisal	.16	"	—
Manila	—	"	—

PHILADELPHIA

Domestic Rags (New)

(Price to Mill)

Shirt Cuttings—	
New White No. 1	.07¾
New White No. 2	.05¾
Light Silesias	.05¾
Black Silesias, soft	.03½
New Unbleached	.07½
Washable Prints	.04¼
Washable No. 1	.03
Blue Overall	.05½
Cottons—According to grades—	
Washable Shredding	.01¾
Fancy Percales	.04¼
New Black Soft	.03¼
Khaki Cuttings—	
Unbleachable Cotton Cuttings	.03½
Bleachable Cotton Cuttings	.04¼
Men's Corduroy	.03½
Ladies' Corduroy	.03
Percales	.03¼

Domestic Rags (Old)

White No. 1—Repacked	3.80	@	—
Miscellaneous No. 1	3.20	"	—
Miscellaneous No. 2	2.65	"	—
White No. 2—Repacked	2.90	"	—
Thirds and Blues—			
Miscellaneous	1.80	"	—
Repacked	2.20	"	—
Black Stockings—			
(Export)	Nominal		
Roofing Stock—			
Foreign No. 1	Nominal		
Domestic No. 1	1.55	"	—
Domestic No. 2	1.45	"	—
Roofing Bagging	1.35	"	—
Old Manila Rope	5.75	"	—

Bagging

(F. o. b. Phila.)

Gunny No. 1—			
Foreign	Nominal		
Domestic	3.00	@	3.50
No. 1 Clean bright—			
Sisal Strings	.04	"	—
No. 2 Clean bright—			
Sisal Strings	.03	"	—
Sisal Jute	.02½	"	.02¾
Scrap—			
No. 1	3.25	"	3.50
No. 2	1.75	"	1.80
Wool Tares, heavy	4.00	"	4.25
No. 1 New Light Burlap	3.00	"	4.00
New Burlap Cuttings	3.75	"	4.00

Old Papers

(F. o. b. Phila.)

OPA Maximum Prices, Baled

No. 1 Hard White Envelope Cuts, one cut	3.37½	"	—
No. 1 Hard White Shavings, unruled	2.87½	"	—
Soft White Shavings, one cut	2.50	"	—
White Blank News	1.65	"	—
Soft White Shavings, Misc.	2.15	"	—
No. 1 White Ledger	2.30	"	—
No. 2 Ledger, colored	2.00	"	—
No. 1 Heavy Books & Magazines	1.92½	"	—
Overissue Magazines	1.67½	"	—
New Manila Envelope Cuttings	2.65	"	—
No. 1 Assorted Old Kraft	1.75	"	—
No. 1 Mixed Paper	.95	"	—
Box Board Cuttings	.72½	"	—
Kraft Corrugated Cuttings	2.25	"	—
Old Corrugated Containers	1.40	"	—
Overissue News	1.00	"	—
No. 1 News	1.00	"	—

BOSTON

Old Papers

(F. o. b. Boston)

OPA Maximum Prices, Baled

No. 1 Hard White Shavings, unruled	2.87½	@	—
No. 1 Hard White Shavings, ruled	2.50	"	—
Soft White Shavings, Misc.	2.15	"	—
No. 1 Fly Leaf Shavings	1.67½	"	—
No. 2 Fly Leaf Shavings	1.12½	"	—
No. 1 Groundwood Fly Leaf Shavings	1.25	"	—
No. 2 Groundwood Fly Leaf Shavings	.90	"	—
Mixed Colored Shavings	.75	"	—
New Manila Envelope Cuts, one cut	2.87½	"	—
Hard White Envelope Cuts, one cut	3.37½	"	—
Triple Sorted No. 1 Brown Soft Kraft	2.50	"	—
Mixed Kraft Env. & Bag Cuttings	2.75	"	—
Kraft Envelope Cuttings	3.25	"	—
No. 1 Heavy Books & Magazines	1.92½	"	—
New Manila Envelope Cuts, one cut	2.87½	"	—
New Manila Envelope Cuttings	2.65	"	—
White and Colored Tabulating Cards	2.25	"	—
Ground Wood Tabulating Cards	1.35	"	—
White Blank News	1.65	"	—
No. 1 Assorted Old Kraft	1.75	"	—
No. 1 Mixed Paper	.95	"	—
Overissue News	1.10	"	—
Box Board Cuttings	.72½	"	—
New Corrugated Cuttings, Kraft	2.25	"	—
Old 100% Kraft Corrugated Containers	1.75	"	—
Old Corrugated Containers	1.40	"	—
Jute Corrugated Cuttings	1.07½	"	—

Bagging

(F. o. b. Boston)

Gunny Bagging—			
Foreign	(nominal)		
Domestic	2.75	@	2.90
Sisal Rope No. 1	*4.75	"	—
Sisal Rope No. 2	* —	"	4.00
Mixed Rope	—	"	1.55
Transmission Rope—			
Foreign	(nominal)		
Domestic	2.75	"	3.00
Manila Rope—			
Foreign	(nominal)		
Domestic	5.75	"	—
Soft Jute Rope	4.50	"	5.00
Jute Carpet Threads	3.00	"	3.50
Bleachery Burlap	8.50	"	9.00
Scrap Burlap—			
Foreign	(nominal)		
Domestic	3.00	"	3.25
South American	—	"	3.25
Wool Tares—			
Foreign	(nominal)		
Domestic	4.25	"	—
Aust. Wool Pouches	—	"	3.65
New Zealand Wool Pouches	—	"	3.50
New Burlap Cuttings	4.75	"	5.00
Heavy Baling Bagging	4.00	"	4.25
Paper Mill Bagging	2.50	"	3.00
No. 2 Roofing Bagging	1.35	"	—

* OPA Maximum Prices.

Domestic Rags (New)

(F. o. b. Boston)

Shirt Cuttings—			
New Light Prints	.04½	@	.04¾
Fancy Percales	.04¼	"	.05
New White No. 1	.06¾	"	.07
New Light Flannelettes	.05½	"	.06
Canton Flannels, Bleached	.06	"	.06¼
Underwear Cutters, Bleached	.06¼	"	.06¼
Underwear Cutters, Unbleached	.05¾	"	.06
Silesias No. 1	.06	"	.06¼
New Black Silesias	.03	"	.03¼
Red Cotton Cuttings	.03½	"	.04
Soft Unbleached	.06½	"	.06¾
Blue Cheviots	.05½	"	.06
Fancy	.02¾	"	—
Washable	.02¾	"	—
Khaki Cuttings	.02¾	"	.03
O. D. Khaki	.03½	"	.03¾
Corduroy	.03¼	"	.03½
New Canvas	.06¼	"	.06½
B. V. D. Cuttings	.06¼	"	.06½

Domestic Rags (Old)

(F. o. b. Boston)

White No. 1—			
Repacked	3.80	@	—*
Miscellaneous	3.20	"	—*
White No. 2—			
Miscellaneous	2.65	"	—*
Twos and Blues, Repacked	2.20	"	—*
Old Blue Overalls	2.25	"	2.50
Thirds and Blues, Repacked	2.20	"	—*
Miscellaneous	1.80	"	—*
Black Stockings	3.50	"	4.00
Roofing Stock—			
No. 1	1.55	"	—*
No. 2	1.45	"	—*
No. 3	1.35	"	—*
No. 4	1.35	"	—*
No. 5, Quality A	1.35	"	—*
Quality B	1.20	"	—*
Quality C	.95	"	—*
Old Manila Rope	5.75	"	—*

* OPA Maximum Prices.

Foreign Rags

(F. o. b. Boston)

Canvas	(nominal)
Dark Cottons	(nominal)
Dutch Blues	(nominal)
New Checks and Blues	(nominal)
Old Fustians	(nominal)
Old Linsey Garments	(nominal)
New Silesias	(nominal)

CHICAGO

Waste Paper

(F. o. b. Chicago)

OPA Maximum Prices, Baled

Shavings—			
No. 1 Hard White Envelope Cuts, one cut	3.37½	@	—
No. 1 Hard White Shavings, unruled	2.87½	"	—
No. 1 Soft White Shavings	2.50	"	—
No. 1 White Ledger	2.30	"	—
No. 1 Heavy Books & Magazines	1.92½	"	—
White Blank News	1.65	"	—
Mixed Kraft Env. & Bag Cuttings	2.75	"	—
No. 1 Assorted Old Kraft	1.75	"	—
Overissue News	1.10	"	—
No. 1 News	1.00	"	—
No. 1 Mixed Paper	.95	"	—
No. 1 Roofing Rags	1.55	"	—
No. 1 Roofing Bags	1.45	"	—

TANNATE WATERSHED LEATHER BELTING

The Belt that's made to stand up in the Paper Mill atmosphere

Tannate Watershed Leather Belting is made with waterproof cement, and treated to resist moisture, so that even when damp it will carry nearly a full load. This is very important in paper mill service where hot, humid conditions often exist—but what is more important is that Tannate enables you to get greater machine output at lower unit cost.

Because of its high coefficient of friction and flexibility, Tannate has exceptional pulley grip. Also it has a high overload capacity and an average strength 1/3 to 1/2 greater than most first quality oak belting. For long life service with little maintenance—equip with Tannate Watershed.

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Equip with RHOADS
Tannate
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LEATHER BELTING

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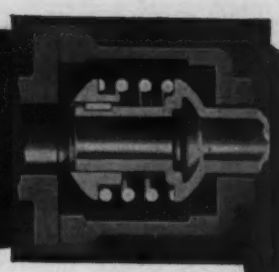
Rotary Pressure
JOINTS



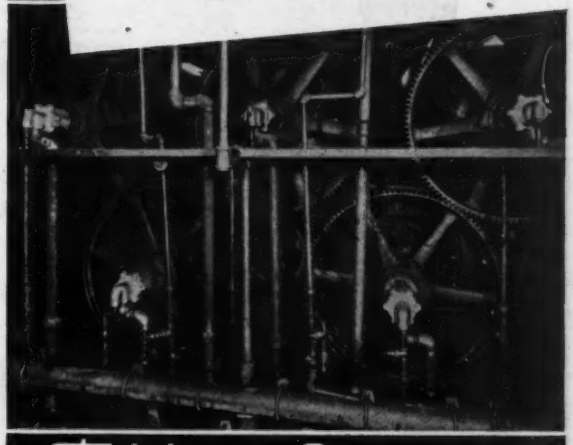
YEARS AHEAD IN DESIGN— *and right in the nick of time*

● Compared to the old style stuffing boxes and steam fits, the Johnson Rotary Pressure Joint is literally years ahead. Fortunately for wartime industry, it was ready and waiting when today's call for more and more production came along.

Its packless, self-oiling, self-adjusting, self-aligning design has released for other work countless man-hours otherwise needed for maintenance. It has saved much valuable production time otherwise lost when machines are shut down to repack stuffing boxes or repair the ravages of misalignment. The way it lends itself to modern methods of syphon roll drainage has helped to step up operating efficiency in hundreds of mills.

Today these time-saving, production-boosting features of the Johnson Joint are of first consideration. At the same time remember that the Johnson Joint can pay its own way out of savings. That will give you an idea of the peacetime possibilities of Johnson Joints, and of the mill that is equipped with them.

Write for complete information



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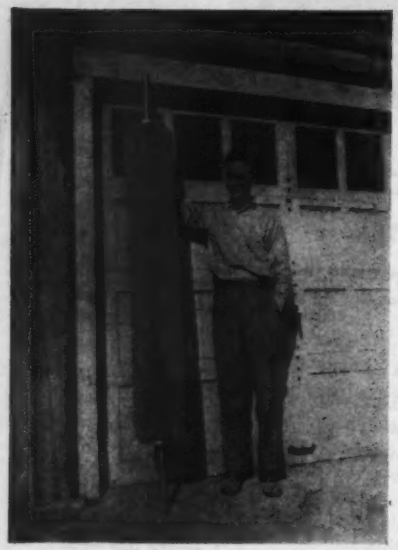

This brush, one of the largest employed in paper making is 144" long. It is used to sprinkle tissues.

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For the paper industry these metal core brushes include those for coated paper mills, for spraying colors, for wetting tissues, and other purposes.

The Metal Cores, of aluminum or cold drawn steel, are practically indestructible. They assure permanent alignment and balance, and can be rewound with new bristle repeatedly.

Both nylon bristle and natural bristle are furnished as required.

A 144 inch Jenkins metal core brush is shown in the picture. In such long brushes the metal core gives sag-free satisfaction that cannot be obtained with wood cores.

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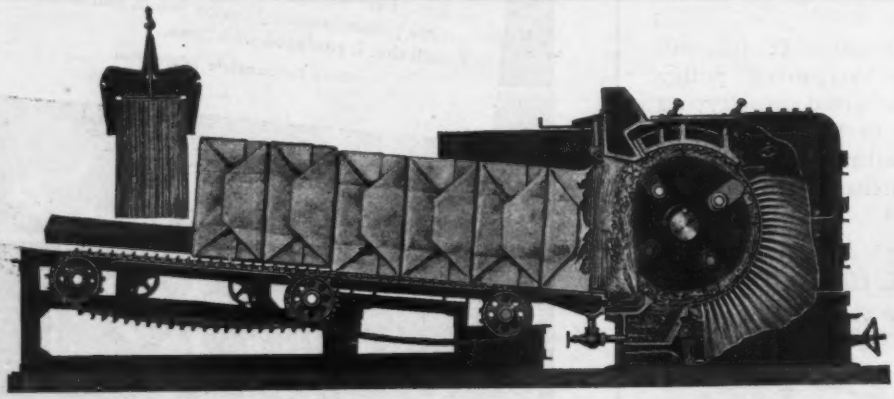
Jenkins Industrial Brushes



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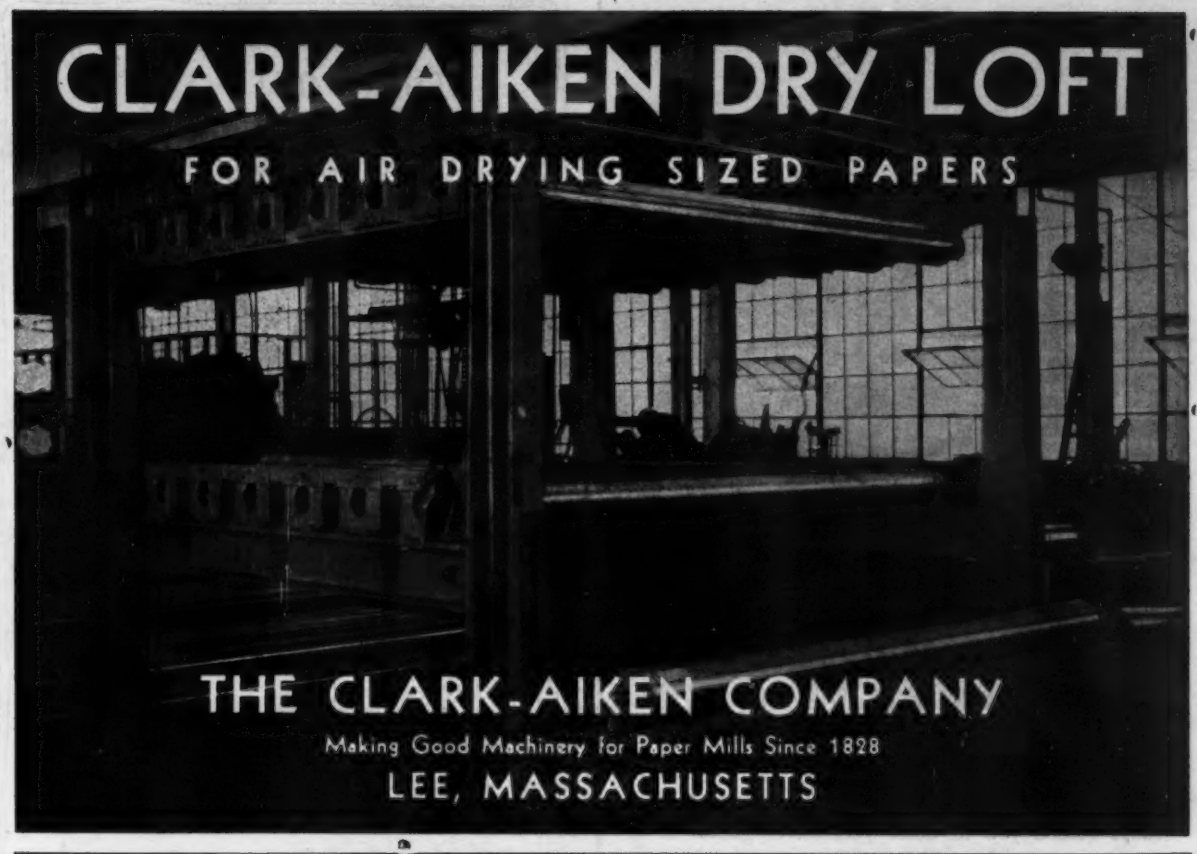

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LEE, MASSACHUSETTS

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with Magnus Slime Remover

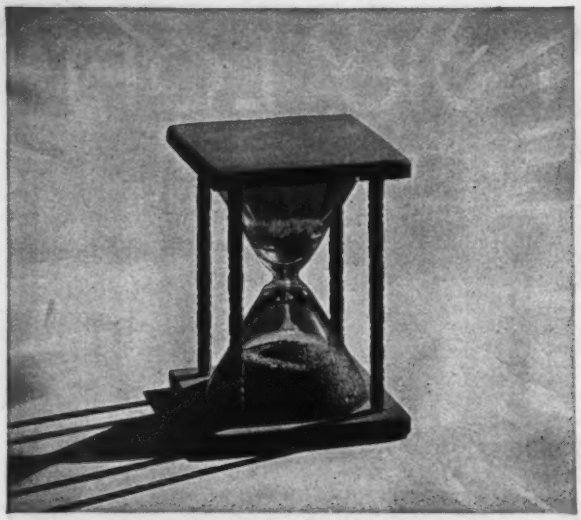
No paper mill today can afford to waste time on manual clean-ups to remove slime deposits. Nor can any chances be taken of shut-downs and excessive rejects of paper caused by neglected slime growth. After all, slime grows while the machines are running, as well as when the system is shut down.

Magnus Slime Remover, consistently used, will keep slime troubles at a low level, and require a minimum use of labor in controlling slime. It not only loosens and disperses deposits so that they can be flushed clear of the system, but also tends to inhibit slime growth by killing the bacteria and micro-organisms that cause it.

There is a whole series of Magnus Cleaners and Compounds to help you keep 'em rolling faster, including Magnus Beatex for putting water into the stuff faster, and Magnus Felt Conditioners for adding extra service life to felts. Ask us for complete details.

MAGNUS CHEMICAL CO. 24 SOUTH AVENUE, GARWOOD, N. J.

Magnus Paper Mill Cleaners



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APPLETON WOOLEN MILLS - APPLETON, WIS.

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SOLUBLE SILICATES help to stretch pulp, to increase volume, and to improve quality. The catalog of 50 grades of PQ silicates includes liquids, powders, solids, which range from $3Na_2O$, $2SiO_2$ to Na_2O, $3.9SiO_2$. This variety provides an interesting array of characteristics which fit them into a number of paper mill processes. For instance:

Paper Sizing: "S" Brand silicate (Ratio 1:3.90) by chemical reaction with alum has long served as a fibre extender . . . it tucks in the short fibres. It improves finish by retaining more starch, clay, rosin.

De-inking: Metso, Sodium Metasilicate ($Na_2SiO_3 \cdot 5H_2O$) due to quick wetting, effective dispersing and emulsifying action yields cleaner, whiter pulp from waste paper stocks.

Other PQ silicates serve the paper industry as deflocculating agent, coagulating agent, adhesive, binder.

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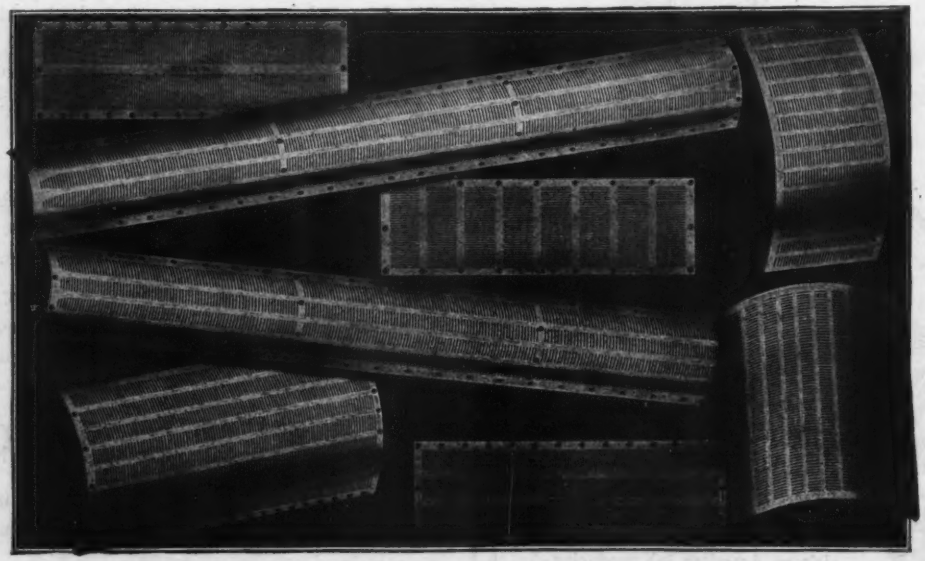

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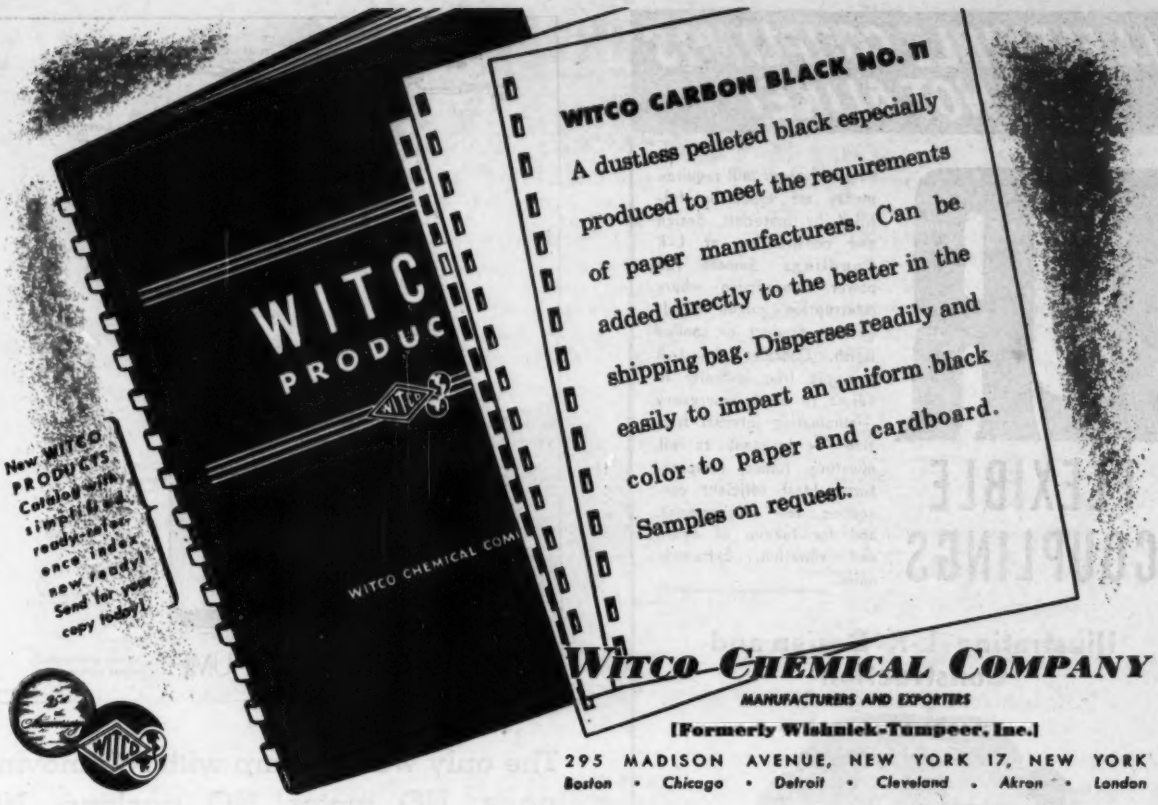
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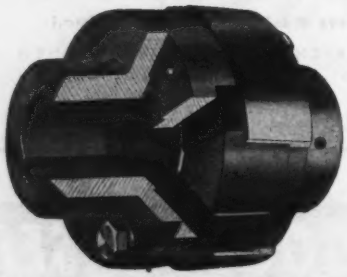

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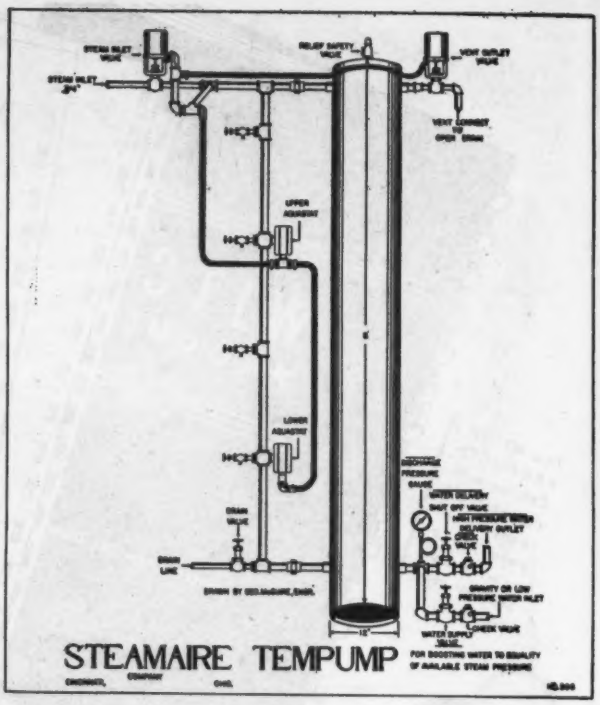

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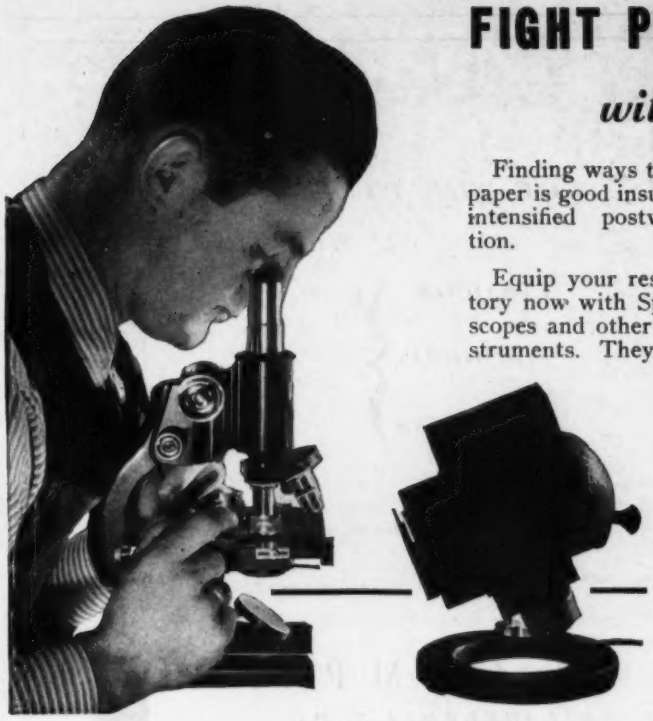
FIGHT POSTWAR COMPETITION
with Better Paper



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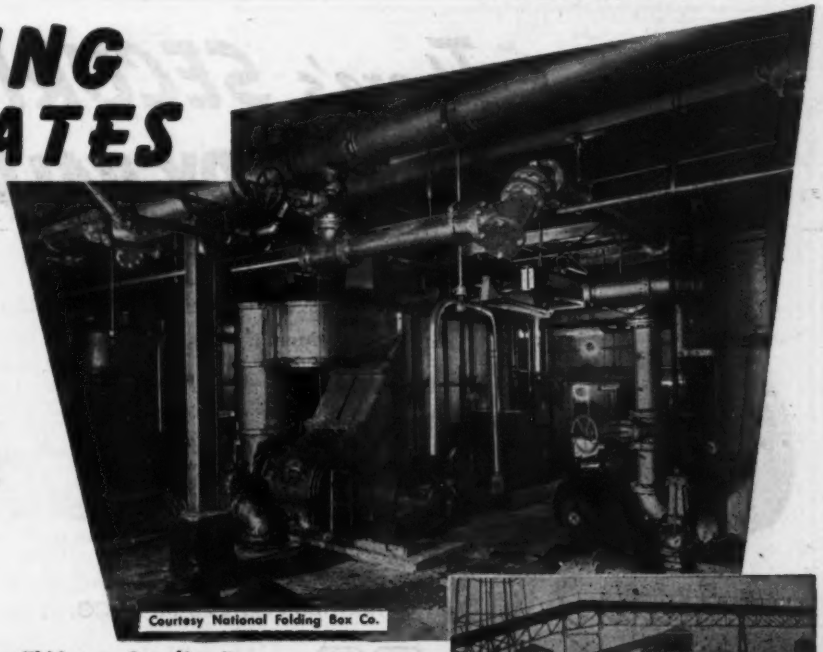

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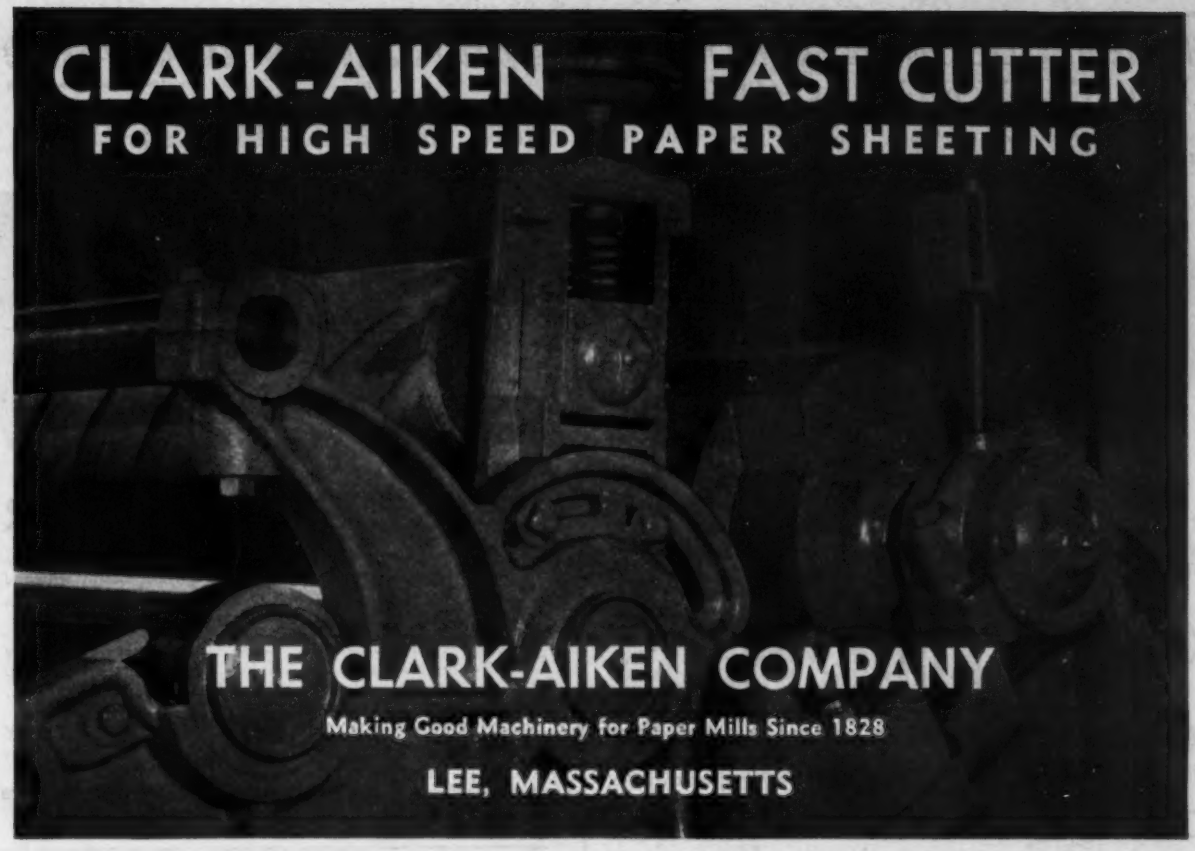

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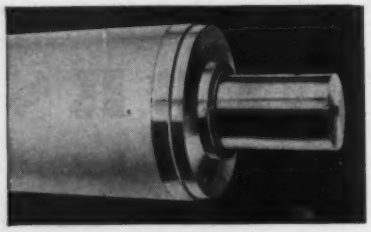

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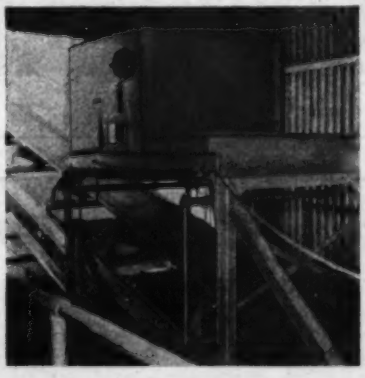
Use it, too, for weighing your refuse, lime, sulphur, etc. Some of the old mills of the South and more of the new ones use the Weightometer as an effective aid to plant control.



Installation of Weightometer on chip conveyor.

Instruction Bulletin 375S will be gladly mailed to you.

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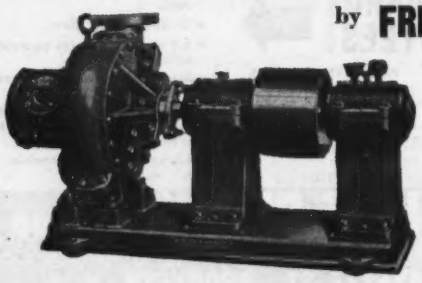

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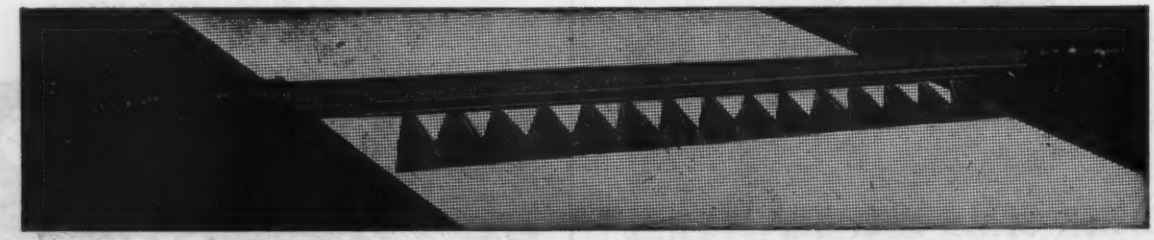

Bulletin 134 **SANDUSKY FOUNDRY & MACHINE CO.** Sandusky, Ohio

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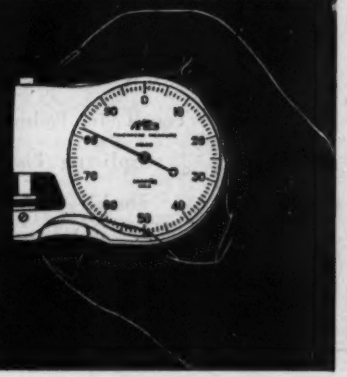

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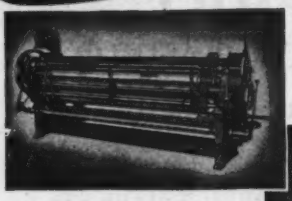
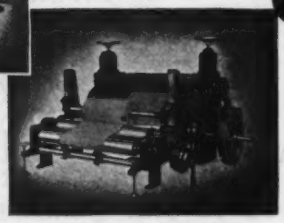


Only two of the many production machines in our line—complete details upon request.



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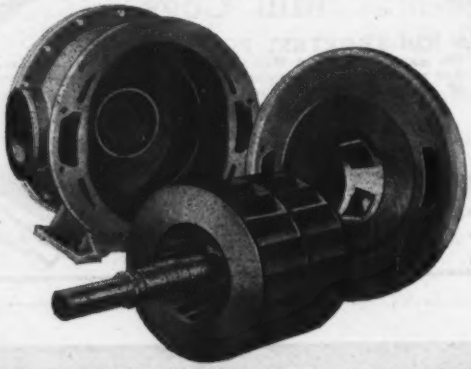

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METALS — I.B.B.M., oil iron, bronze or stainless steels, body parts plain or rubber lined.

The photo of 24" Fig. 241 I. B. B. M. valve while illustrating the gate bottom wedge system for forced gate seating and "GUILLOTINE" edge for shearing fibre at seat also shows the packing box and yoke as separate units. Both adjustable.

• The "FAST THREADED" screw stem and ball bearing speeds valve operation.

• The packing box is extra deep, is adjustable and provided with specialized lubricated packings and special type gland and compression bolts.

• The yoke mountings are such that yokes for various methods of gate operation are interchangeable.

• Replaceable gate edge shoes are used in valves 10" and larger. These shoes are of special value when valves are installed stem and pipe horizontal.

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Plant engineers, master mechanics, mechanical engineers, draftsmen and designers
Chief engineer (power)
Finishing foreman
Tour boss (several)
Chemists
Machine and back tenders, beater engineers, etc. etc.

We invite correspondence (strictly confidential) with employers seeking personnel and men seeking new positions. S-27

WANTED

PULP AND PAPER MILL ENGINEERS—RESIDENT ENGINEER for construction new kraft mill in the South and plant engineer after completion. Also general designing engineers and draftsmen experienced in industry. Replies held confidential. Address Box 45-614, Paper Trade Journal. O-18

MACHINE TENDER for cylinder machine operations. Must be experienced at this particular kind of machine operations. Prefer high school graduate or equivalent. Address Box 45-293 care Paper Trade Journal. TF

WANTED — ENGINEERS — Capable of handling general engineering work in established consulting engineers office specializing in pulp and paper mills. Address Box 45-469 care Paper Trade Journal. TF

MERCHANDISE AND SALES MANAGER for nationally known paper bag manufacturing company seeking to develop sales of special purpose and transparent bags and flexible containers—opportunity—replies considered in strictest confidence—state experience and minimum compensation. Our employees aware of this advertisement. Address Box 45-529 care Paper Trade Journal TF

WANTED—Mechanical Engineering Draftsmen with several years experience in chemical plant layout, process equipment design, piping for chemical company in East. State age, experience, salary expected. Address Box 45-554 care Paper Trade Journal. S-27

WANTED—Tour Boss, Machine Tender, Back Tender, Shipping Clerk for one machine mill making folding grades. Extensive rebuilding program under way. Excellent opportunity for right men. Address Box 45-541 care Paper Trade Journal. O-25

WANTED—Chemical Manufacturer has openings for Chemists or Chemical Engineers with experience in the Pulp and Paper Industry. Graduate training in Chemistry, or experience in the paper converting, synthetic resins, or plastics fields would be helpful. Address Box 45-559 care Paper Trade Journal. S-27

MACHINE DESIGNER preferably with experience in paper mill or paper working machinery. Permanent position with good opportunity advancement. Location Brooklyn, New York. State complete details, age, experience and salary expected. Address Box 45-578 care Paper Trade Journal. TF

WANTED—Graduate Chemist with at least 1 yr. experience in a paper mill for research and development work in a well established chemical house in Western Pennsylvania. Excellent opportunity to get into Sales and Technical Service. Apply in own handwriting giving references, experience and personal history. Address Box 45-589 care Paper Trade Journal. O-11

LARGE EXPORT CONCERN wants assistant with thorough knowledge paper branch. Knowledge Spanish preferred but not essential. Ex-serviceman preferred. Address Box 45-594 care Paper Trade Journal. S-27

WANTED—One man to represent an Eastern paper converting mill through New York State. We will prefer one who has had some experience in paper sales, and who resides in the vicinity of Syracuse, N. Y. Address Box 45-596 care Paper Trade Journal. D-20

WANTED—Draftsmen experienced in plant layout and building design; draftsmen for high pressure & process piping. New York City office. Address Box 45-577 care Paper Trade Journal. O-4

HELP WANTED

MASTER MECHANIC

to take full charge of maintenance in Asphalt Roofing Plant. Western New York location. Excellent salary for the right man. Give full particulars in first letter. All replies in strictest confidence. Address Box 45-533, Paper Trade Journal. TF

Wanted
ASSISTANT TO CHIEF ENGINEER

To take complete charge of our Power Plant supervising the operation and maintenance of high pressure boilers, turbines, and auxiliary equipment. Young man with both technical and practical background preferred. Excellent opportunity for growth in responsibilities. Give complete personal and business history in letter of application.

FORT HOWARD PAPER COMPANY
Green Bay, Wisconsin O-4

PAPER CHEMIST—For printing ink development in laboratory of large ink manufacturer. Prefer paper experience. Preferably under 35. No ink experience necessary. Excellent opportunity for advancment. Chicago area. Address Box 45-564 care Paper Trade Journal. S-27

CLASSIFIED ADVERTISING

HELP WANTED—5c a word. Double rate for heavy face type. Minimum charge $1.25.

SITUATIONS WANTED—5c a word, double rate for heavy face type. Minimum charge $1.25. If repeated ½ rate will be charged for each consecutive repetition.

FOR SALE—5c a word. Double rate for heavy face type. Minimum charge $1.25.

WANTED—5c a word. Double rate for heavy face type. Minimum charge $1.25.

OPPORTUNITIES—5c a word. Double rate for heavy face type. Minimum charge $1.25.

Classified advertising space may also be purchased at $3.00 per single column inch.

All classified advertisements are payable in advance.

If box number is used—35 cents additional.

Address Replies

to advertisements appearing under Box Numbers in care of

PAPER TRADE JOURNAL
15 West 47th Street
New York 19, N. Y.

HELP WANTED

SALARIED POSITIONS

$2,500-$25,000. Reconversion is creating lifetime opportunities now. This thoroughly organized confidential service of 35 years' recognized standing and reputation carries on preliminary negotiations for supervisory, technical and executive positions of the calibre indicated. Retaining fee protected by refund provision. Identity covered and present position protected. Send only name and address for details.

R. W. BIXBY, INC.
117 Delward Bldg., Buffalo 2, N. Y. TF

PLANT ENGINEER

To take charge of all plant engineering, maintenance and construction work, including steam and electric power plant. Must be thoroughly experienced, energetic, capable and reliable. Mill located in good midwest city. Give full particulars in first letter, including experience, references, availability and salary expected. Interview can be arranged at company expense and all replies will be treated confidentially. Box 45-580 care Paper Trade Journal. O-11

MASTER MECHANIC

To take charge of maintenance in modern Board Mill and Paper Box plant. Man with wide experience in power plants and steam problems preferred. Plant locatd in Connecticut. Address Box No. 45-624 c/o Paper Trade Journal. S-27

HELP WANTED—Engineer-Draftsman, age 30 to 40 years for large mill in East. Should have experience in layout and design of paper mill machinery and general engineering. Excellent future for the right man. In reply give full information. Address Box 45-604 care Paper Trade Journal. O-4

SALES ENGINEER with knowledge of Pulp and Paper Machinery and experience in merchandising. Write giving background, references and salary expected. Address Box 45-606 care Paper Trade Journal. TF

SALESMAN—For New York area, preferably with knowledge of plastic coated and laminated paper products. Sell to paper merchants and industrial accounts. A specialty line with a ready market. Write fully qualifications. Address Box 45-608 care Paper Trade Journal. S-27

TOUR BOSSES wanted for Roofing Felt Mills located in New Orleans and Metropolitan New York Area. Send complete resume giving experience, etc., to Box 45-609 care Paper Trade Journal. O-4

WANTED—Tour Boss, experienced in the manufacture of folding and Set-up Boxboards of all kinds, also experience in the manufacture of corrugating medium preferable. Mill located in Central United States. Address Box 45-610 care Paper Trade Journal. O-4

WANTED—Two experienced Back Tenders and one experienced Paper Mill Millwright for general maintenance and repairs in small one machine Fourdrinier Mill. Rochester Paper Company, Rochester, Michigan. O-4

DRAFTSMAN WANTED—Must be experienced in plant layout and building design, preferably with paper mill experience. Address Box 45-615 care Paper Trade Journal. S-27

PAPER BOARD MILL SUPT. Unusual opportunity in Mass. mill making high grade paperboard—jute test liner, patent coated, special set up boxboard, match splint stock, etc. Address Box 45-617 care Paper Trade Journal. O-4

WANTED—Man to represent an Eastern Paper converting mill throughout the New England States. We will prefer one who has had some experience with the jobbing trade in this area, and who resides in the vicinity of Boston, Mass. Address Box 45-616 care Paper Trade Journal. TF

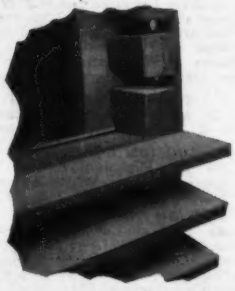
WANTED—Layout Man experienced on pulp and paper mill machinery. Give employment history and background in first letter. Valley Iron Works Co., Appleton, Wisconsin. N-1

CALLING DR. DILTS

On beater repairs, that's exactly what the more far[illegible]ted mills are doing—calling Dr. Dilts—headquarters for be[illegible]

BARS • WOOD FILLINGS • ROLLS
LIGHTER STANDS • HOODS
BEDPLATES • VALVES, ALL TYPES

Do not wait until your beaters give off their last gasp and force you down. Remember — even the simplest repair takes time. Write



BLACK-CLAWSON CO., Hamilton, Ohio

Divs.: Dilts Machine Works, Fulton, N. Y.
Shartle Bros. Machine Co., Middletown, O.
Associate: Alexander Fleck, Limited, Ottawa, Can.

BEATER REPAIRS

SITUATIONS WANTED

ASSISTANT SUPERINTENDENT OR SUPERINTENDENT

Age 32. Jobs held—Fourth Hand to Spare Machine Tender, Assistant Superintendent. Technical education. Five years practical experience on book papers, plus five years in management, making kraft specialties, including creped. Fourdriniers. Dependable. Get along well with others. Address Box 45-555 care Paper Trade Journal. S-27

PAPER MILL ENGINEER MILL SUPT.

20 years various mills. Experienced all phases administration, production, operation, development, reconstruction. Good organizer. Desires change. Personal reasons. Seeking opportunity to manage mill. Replies confidential. References. Address Box 45-566 care Paper Trade Journal TF

PAPER SALESMAN at present covering the jobbing trade in Pennsylvania, New Jersey, Delaware, Maryland, Virginia and North Carolina as a mill representative desires to operate over the same territory as a representative for three of four non-conflicting lines. Address Box 45-435 care Paper Trade Journal. O-25

POSITION WANTED as TOUR BOSS on cylinder board. 42 years old and married. Available at once. Address Box 45-587 care Paper Trade Journal. S-27

SITUATIONS WANTED

PLANT ENGINEER with long experience in pulp and paper mill engineering, construction and maintenance, also operation of electrochemical and power plants. Address Box 45-580 care of Paper Trade Journal. O-4

BEATERROOM SUPERINTENDENT or foreman, 55 years old. 35 years theoretical and practical experience on most kinds of paper. Good on color. Address Box 45-484 care Paper Trade Journal. S-20

SALES REPRESENTATIVE—With long experience in pulp and paper field. Available immediately to a good organization. University education. Age 45. Can give to a firm both high type and forceful representation. Address Box 45-567 care Paper Trade Journal. S-27

PURCHASING AGENT—Veteran of World War I and II, with 20 years experience purchasing and contracting for lumber, pulp and paper mills, and for Army, open for position requiring responsibility and initiative. Familiar with rail and water transportation, salvage sales, handling personnel. Address Box 45-574 care Paper Trade Journal. S-27

PERSONNEL DIRECTOR—Broad industrial experience. B.A. and L.L.B. Degrees. Extensive union negotiations background. Experienced in all phases employer-employee relationships including job evaluations etc. Address Box 45-561 care Paper Trade Journal. O-11

AVAILABLE AS PLANT MANAGER—SUCCESSFUL EXECUTIVE WITH FIFTEEN YEARS EXPERIENCE IN THE PULP, PAPER AND COATING INDUSTRY, HAVING BACKGROUND OF TECHNICAL TRAINING, DESIRES POSITION AS PLANT MANAGER. Address Box 45-583 care Paper Trade Journal. O-4

SITUATIONS WANTED

BINDERS BOARD—ENGINEER—25 years broad practical experience in controlled factory production, breaking up complex bottle necks, formulating workable plans, producing schedules on time, install and operate them. Desires position as assistant to general manager or plant manager. Address Box 45-622 care Paper Trade Journal. S-27

TEXAS-LOUISIANA. Spade work in this market for quality printing paper should begin now. Write resident, 32, college graduate, publicity and graphic arts experience, to discuss sales representation. Address Box 45-585 care Paper Trade Journal. O-11

WANTED—Position as Purchasing Agent. 25 years experience in roofing felt mills. Familiar with rag and paper markets and purchases of all types of mill equipment and supplies. Mechanical engineer and draftsman by education and practical experience. Address Box 45-602 care Paper Trade Journal. S-27

ENGINEER-CHEMIST —EXPERIENCED IN THE PAPER INDUSTRY. IS AVAILABLE FOR POSITION AS TECHNICAL OR RESEARCH DIRECTOR WITH RELIABLE FIRM IN THE PAPER, CELLULOSE OR PLASTICS FIELD. THIS MAN TRAINED IN CHEMISTRY, PHYSICS AND CHEMICAL ENGINEERING. HAS HAD FIFTEEN YEARS EXPERIENCE IN THE PAPER, PULP AND PRINTING INDUSTRIES. Address Box 45-584 care Paper Trade Journal. O-4

FOURDRINIER EXECUTIVE—Now in consulting work on the Pacific Coast, will shortly be available for permanent connection on fine papers. Reconversion, personnel, developing profitable market. Intimate knowledge of papermaking. Complete supervision required. Salary and tonnage arrangement. Results guaranteed. Address Box 45-600 care Paper Trade Journal. S-27

FOR SALE

BEATERS
2—2000 lb. Holyoke Iron Tub Beaters.
1—1000 lb. Dayton Beater.
3—400 lb. Gavit—iron tub beaters.

CALENDER STACKS
1—11-Roll 92" Face Calender Stack—complete with Drive.
1—36" 7-roll—Holyoke Machine.
1—60" 4-roll Downingtown (heavy duty).
1—77" 2-roll—Moore & White.
1—76" 8-Roll Farrel.

CENTRAP
1—Shartle Brothers Centrap.

CYLINDER MOULDS
1—48" Diameter x 96" Face.
6—30" diameter x 72" face.
3—30" diameter x 74" face.

DIESEL ENGINE
1—60 H.P. Fairbanks Morse Diesel Engine, connected to a 40 KVA Generator.

DRIVES
1—D. O. James 75 H.P. Speed Reducer with couplings and motor base. Ratio 2.16 to 1. 900 RPM to 418 RPM.
1—Pulmax Drive.

DRYERS
23—36" diameter x 82" face.
12—36" diameter x 68" face.
13—60" diameter x 154" face.
1—48" diameter x 94" face.
1—24" diameter x 84" face. (Baby).
1—16" diameter x 84" face. (Baby).
1—36" diameter x 116" face.
2—28" diameter x 68" face.

EMBOSSER
1—28" two roll Embossing Calender.

ERKENSATORS
2—I. W. E. Erkensators—bronze construction—complete with motors, starters and distributing box.

FLAT SCREENS
2—8 plate Flat Screens.
1—18 plate Flat Screen, with scraper.
1—12 plate Flat Screen.
2—12 plate Packer Type Flat Screens with steel vats

JORDANS
1—#2 Miami Jordan.

JORDANS
1—Pony Horne Jordan. Spare New Fillings
1—Black-Clawson Jordan (belt driven).
1—#9 Emerson Jordan—for direct connection of a motor — requires use of 400 H.P motor.
1—Smith & Winchester.

MOTOR
1—150 H.P. G. E. Induction Motor—3/60/220-875 r.p.m.—including starting equipment.

PULP EQUIPMENT
1—84" Carthage Chipper—complete and in excellent condition.
1—32" three pocket Glens Falls Grinder (for 27" wood).
3—Rotary incinerators—9' diameter x 20' long.
4—27" four pocket Sandy Hill grinders (for 24" wood—including 1000 H.P. motor for each, starting equipment, etc.).

PULPERS
1—#2 Lannoye Pulper.
1—Jones Pulper — direct connected to 60 H.P. motor—3 phase, 60 cycle, 440 volts —forward and reverse starting.

PUMPS
1—Buffalo Pump—5500 g. p. m., direct connected to 100 H.P. Motor (30' head).
1—Shartle Brothers duplex 10 x 20 stock pump.
1—Moore & White triplex 10 x 12 stock pump.
3—Worthington Turbine Well Pumps—300 g.p.m. for 14' and 16' depths—with motors.
Various sizes of Centrifugal and Plunger Pumps. Write us regarding your particular requirements.

REELS
1—2 Bowl Reel — 112" face — bowls 20" diameter.
1—2 Bowl Reel—63" face.
1—2 Bowl Reel—110" face.
1—2 Drum Reel—72" face.

REFINERS
2—#1 Claflin Refiners.

ROLLS
500—Brass tube—steel tube—rubber covered iron rolls—various sizes.

RUBBER COUCH ROLL
1—72½" Face x 9" diameter (soft rubber)

SAVEALL
1—Saveall 36" x 136" cylinder mold, antifriction bearing equipped, including couch roll.

SCREW PRESS
1—Valley Iron Screw Press.

SHREDDERS
1—#25 CRSE Mitts & Merrill Hog.
1—Gilman Shredder—used one year.

SHEETERS
1—103" Hamblet Single Knife Sheeter, complete with slitting device.
1—110" Horne single knife rotary sheet cutter
1—48" Langston heavy duty chopper (this is a combination machine, combining a slitter, scorer, sheeter and chopper.)

SIZING MACHINE
1—36" Waldron sizing machine.

SLITTERS
1—114" Two drum Langston Slitter & Winder.
1—110" Beloit slitter (slitter attachment only)
1—114" Two drum Kidder slitter and winder.
1—36" Koegel slitter and winder.
1—72" Moore & White shaft winder.
1—4 Drum 108" trim Moore & White.

STEAM ENGINE
1—100 H. P. Ames Steam Engine connected to a 75 K. W. Westinghouse Generator.

SUCTION BOXES
1—Nash 100" face Suction Box.
3—Brass Suction Boxes—90" drilled face
2—Brass Suction Boxes—77½" drilled face

SUCTION COUCH ROLL
1—Sandusky Suction Couch Roll — 18" diameter x 130" face — Complete with Sturtevant Vacuum Pump and drive mechanism.
1—Downingtown Suction Press Roll 24" x 92".

TOILET CONVERTERS
2—63" Dietz Toilet Converters.
1—81" Dietz Toilet Converter.

WINDERS
2—65" Cameron Tensions for Winders.

We are always in the market to purchase your surplus or idle machinery. What have you to offer?

Wanted Cylinders and Fourdrinier Machines (complete mills). What have you to offer?

J. J. ROSS CO., 250 Frelinghuysen Avenue, Newark 5, New Jersey
TEL. BIGELOW 3-3720 5-27

FOR SALE | FOR SALE | FOR SALE

Ross Paper Machinery Co., 17 Porter Ave., Newark 8, New Jersey, Waverly 3-5675

48" Single Cylinder Complete Mill with all auxiliaries.

Additional Information on request.

BEATERS
1—2500 lb. Downingtown Iron Tub
1—750 lb. Downingtown Iron Tub
3—1000 lb. Horne Iron Tub
1—1200 lb. Holyoke Wood Tub

CALENDER STACKS
1—10 Roll Farrell 104" Warren Doctors
1—11 Roll Pusey & Jones 104" Warren Doctors

CONVERTING EQUIPMENT
1—Bliss Double Head Stitcher
1—Bliss Single Head Stitcher
1—Bliss Box Assembling Machine
1—66" Dietz Towel Winder
4—Waterville Grinders
1—42" Parry Liner & Combiner
1—96" Waldron Reeling Machine
1—39" Dampening Machine
1—36" Brush Coating Machine
1—Copper Mixing Tank with agitator—40 gal.
1—Cast Iron Kettle 20" x 24" 2 outlets

DRYERS
19—36" diam. x 68" face—2 deck frames, gears, bearings, etc.
5—48" diam.—102" face—2 deck frames.
40—36" diam. 86" face 3 deck frames
18—36" diam. 82" face 2 deck frames
40—28" diam. 96" face 2 deck frames

FESTOON DRYERS
100" Proctor & Schwartz
60" Proctor & Schwartz

FLAT SCREENS
1—Moore & White 8 Plate
1—Moore & White 10 Plate
2—Sandy Hill Packer 8 Plate with Scrapers.
1—Sandy Hill Packer 10 Plate
1—Trimbey Pulp Screen 30 ton cap.

JORDANS
1—E. D. Jones Standard motor drive
1—Dillon No. 2 Motor drive
1—Appleton No. 2 motor drive
1—Noble & Wood Monarch Belt Drive

KNIFE GRINDER
1—72" Seybold automatic used one year

MISCELLANEOUS
1—Warren Broke Target with pump
2—Yankee Dryer doctor oscillators (Beloit)
2—Nugent Oil Filters (new)
2—Beloit Fourdrinier Shakes

MOTORS
1—30 h.p. 600 R.P.M. 2300 V. 3 Ph. 60 cy.
1—40 H.P. 3600 R.P.M. 2300 V. 3 Ph. 60 cy.

PLATERS
2—Holyoke 2 Roll 18" dia. 36" face

PULP EQUIPMENT
2—Pusey & Jones vertical Digesters (welded) 7' dia., 24' high 125 lb. pressure
8—Horizontal Digesters 13' diam. 47' face 150 lb. pressure
3—Improved No. 2 Knotters
1—Nichols-Herreshoff Lime Kiln
1—Williams No. 30 Bark Hog
1—Sumner Disc Barker 72" dia.

PULPERS
1—Sturtevant Bale Pulper with conveyor & motors used three years.
1—Voith Pulper No. 1-20 tons cap.

PUMPS
1—Pusey & Jones 5" x 8" Stock.
1—DeLaval 6" x 6"
1—Oliziti Acid 3" Suction.
1—Frederick 600 g.p.m. 50' head (stock)
1—Midwest 6" stock pump

REELS
2—Pusey & Jones 104" face 18" dia. bowls
1—Pusey & Jones 115" face 18" dia. bowls
1—2-bowl 100" face 20" dia. bowls

RIGHT ANGLE WORM GEAR DRIVES
1—Cleveland 2 H. P.—10 to 1 ratio.
1—Philadelphia 15 H. P.—60 to 1 ratio.
1—Oliver 5 H. P.—51 to 1 ratio.
1—Grant 2 H. P.—34¼ to 1 ratio.
1—Cleveland 2.3 H. P.—40 to 1 ratio.
1—Cleveland 1.2 H. P.—60 to 1 ratio.
1—Grant 2 H. P.—7 to 1 ratio.
1—Philadelphia 2 H. P.—600 to 1 ratio.
1—Philadelphia 15 H. P.—60 to 1 ratio.

SATURATOR
1—Guyton-Cumfer 5 gates

SAVEALL
1—A. D. Wood cylinder 48" dia. 60" face
1—No. 4 Bird with motor and speed reducer 16" diam. rubber couch.

SHEET CUTTER
120" Hamblet Duplex with layboy and 24 roll backstand.

SLITTERS & WINDERS
1—104" Warren two drum.
1—72" Pusey & Jones two drum.
2—42" Cameron 36—20 slitters with motors.
2—50" Cameron 36—20 slitters with motors.

STUFF PUMPS
1—12" x 12" Goulds triplex
8—10" x 20" Shartle triplex
1—8" x 18" Shartle triplex
1—12" x 16" Shartle triplex
1—8" x 10" Shartle triplex
1—7" x 16" Shartle triplex
1—8" x 18" Shartle duplex

TWISTING MACHINE
1—36 Spindle Brownell Twister with motor.

UNWINDERS
1—52" Johnstone Uniform Tension Unwinder with auto, hydraulic brakes. Used 6 months.
1—42" John Waldron Unwinder. Used 1 year.

VACUUM PUMPS
1—14" x 20" Connersville
1—12" x 18" Connersville

WASHERS (Beaters)
1—54" face—45" diam. with rigging
1—52" face—52" diam. with rigging

AMERICA'S LARGEST BUYERS OF PAPER MAKING MACHINERY

WANTED—THREE CYLINDER AND TWO FOURDRINIER MACHINES FOR EXPORT—ANY WIDTH

SITUATIONS WANTED

MECHANICAL SUPERINTENDENT—Graduate mechanical engineer, Canadina, with ten years experience in all phases of pulp and paper mill maintenance. Desires to contact mill in eastern or central United States. Address Box 45-603 care Paper Trade Journal. O-4

SALESMAN—Familiar with the converting trade and large users of sulphate paper in New England. Would like to contact mill wishing to be represented in this area. Address Box 45-588 care Paper Trade Journal. S-27

SITUATIONS WANTED

CHEMIST—Experienced in all phases of manufacture of surface coated and fancy printed papers, including the finishing operations. Desire to make permanent connection with company engaged in paper coating or in allied field. Address Box 45-601 care Paper Trade Journal. O-11

CHIEF CHEMIST of a Southern Kraft Paper Mill, with diversified experience desires change in same or allied industry. Address Box 45-623 care Paper Trade Journal. O-11

SITUATIONS WANTED

CHEMICAL PROCESS Instrumentation Engineer—Now employed by nationally known industrial instrument company as application engineer in the chemical and pulp fields, desires position as engineering process supervisor, preferably with company owning more than one mill. Age 34. Ch. E degree. 10 years industrial process experience. Your mill efficiency can be increased by proper application of industrial instrumentation. Address reply: Robert D. Cowherd, 37 Arden Way, N. E., Atlanta, Ga. O-4

FOR SALE

ROSS PAPER MACHINERY CO., 17 Porter Ave., Newark, N. J. Waverly 3-5675

1—Westinghouse Turbine Generator 31-25 K.V.A. 600 V 3 ph. 60 cy. Additional Information on Request

1—G.E. Turbine Paper Machine Drive 250 h.p. 350 R.P.M. 125 lbs. steam pressure. Additional Information on Request

Beloit Yankee Drier—186" face—12' diameter with Messinger bearings

4 Driers—60" diameter—175" face, gears and frames. S-27

FOR SALE | FOR SALE | FOR SALE

FOR SALE FOR SALE FOR SALE

ROSS PAPER MACHINERY CO., 17 Porter Ave., Newark, New Jersey

Waverly 3-5675

2 Iron Firemen Stokers complete with undergrate fans, fly-ash fans, Fairbanks Scale Co. weight lory, portable coal conveyor and portable car unloader. All the above is complete with motors and starters. Purchased new 1944 used one year.

Additional information on request. S-27

FOR SALE

REBUILT ELECTRICAL MACHINERY

Slip Ring & Squirrel cage motors 3 ph. 60 cy.

HP	Make	Speed	Voltage	Type
300	West.	1750	2200/220/440	CW
200	G.E.	240	2200/220/440	MT412
150	G.E.	600	2200/220/440	I-12
150	West.	600	220/440	CCL
150	West.	600	220/440	CW
100	West.	1750	2200/220/440	CI

Motor Generator Sets (3ph. 60 cy.)

150 KW G.E. 250/275 v. 900 RPM cpd. wd. dir. con. 225 HP G.E. Syn. Motor 2300 v. 900 RPM.

100 KW Ridgway 250/275 v. 1200 RPM cp. wd. dir. con. 150 HP Ridg. Syn 220/440 v. 1200 RPM.

Large stock of AC & DC Motors.

AC and DC Generating Equipment.

2—300 KW G.E. R. Converters 250 V. DC with transformers 2300 or 4000 Volt.

60 KVA Allis Chal. Turbo 240/3/60.

50 KW Westgh. Turbo 125 Volt D.C.

50 KW Westgh. Engine unit 125 Volt D.C.

Dealing in Rebuilt Electrical Machinery, exclusively, for a quarter of a century.

MOORHEAD-REITMEYER CO., INC.

30th & Brereton Sts. Pittsburgh, Pa.

S-27

REVAMPING AND BUILDING MILL AND CAN OFFER FOR SALE

One large Breaker Beater complete
One small Beater Complete
1—30" Diameter X 90" Face cylinder mold
1—6x8 Shartle Duplex plunger stock pump
1—New pair cast steel double suspension spring type beater bearings for 8" diameter journal —Noble & Wood beater roll. Never used
1—Used old style lighter beam for 8" diameter journal Noble & Wood beater
1—New reinforced design lighter beam for 8" diameter journal—Noble & Wood beater roll. Pattern No. 663. Never used.
3—300 KVA —33000-2300/4000 volts transformers
1—250 H.P. slip ring motors & controls—450 R.P.M.—3 bearing base and pulley
80—32" Face steel dryer felt rolls—1—7/16" journals
1—20" Face cast iron taper pulley—2 15/16" bore taper 31"x29½"
4—36" diameter x 85" face dryers
1—6" to 10" Cox & Sons Pipe threading machine
1—48"x48" Noble & Wood beater roll with filling installed
1—40" Noble & Wood impeller for circulation stock in beater.

A visit to the mill would prove profitable as we have many items for sale to numerous to mention. See our superintendent Mr. O. P. Fussell at our plant in Walloomsac, New York.

WALLOOMSAC PAPER MILLS, INC.
Mills: Walloomsac, New York
Main Office: 25 Vanderbilt Avenue
New York 17, New York TF

FOR SALE

36" Diameter Dryers 85" and 86" Face — 3 Deck — Complete with Stands, Gears and Bearings.

EMPIRE BOX CORPORATION
Garfield, New Jersey
TF

FOR SALE—2 Waldron 7-color Wall Paper Printing Presses; 40" Kidder Slitter. Address Box 45-621 care Paper Trade Journal. O-4

FOR SALE

1 completely rebuilt Rubber Covered Downingtown Suction Press Roll—24" dia x 92" drilled face—practically new.

J. J. ROSS COMPANY
250 Frelinghuysen Ave.
Newark 5, N. J.
Bigelow 3-3720
S-27

FOR SALE

1—Yankee Fourdrinier machine with 10' x 98" dryer
1—144" Pulp Drying Machine
1—120" fourdrinier machine

SHARTLE BROS. MACHINE CO.
Middletown, Ohio
S-28

PAPER MILL & PAPER CONVERTING EQUIPMENT FOR SALE

84" Inman Slitter.
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44" Seybold Holyoke Aut. mill type Power Cutter.
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80" Finley Sheeter.
110" Hamblet heavy duty Sheeter.
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Baling Machines, both hand and power.

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1—60" Universal type 6 Cameron Slitter and Rewinder rebuilt and guaranteed.
1—Paper converting company's quarter fold napkin machine with embossing attachment, suction pump and 5 hp. AC motor.
1—22 Lannoye Pulper complete with 40 H/P A.C. motor equipment. A-1 condition.
1—110" Double-Drum Waldron late type shear cut hydraulic Slitter and Rewinder.
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1—45" up-to-date Beck Rotary Sheet cutter complete with automatic Beck Layboy.
1—34" up-to-date practically new Waldron Embossing Machine with leather design.
2—Laminating machines—one 36" Cameron and one 44" Run Breuer.

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FOR SALE—2 Dandy Rolls, 12" diameter x 118" face, both newly covered. 1 Connersville Vacuum Pump 10" x 24" in good shape. Address Box 45-613 care Paper Trade Journal. O-4

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WANTED—1 or 2 cylinder paper machine to trim either 80", 90" or 96" to make light weights. Address Box 45-546 care Paper Trade Journal. S-27

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Machinery and equipment for mill to produce writing and wrapping paper. Capacity 10-20 tons per 24 hours. Trim desired approximately 82" to 97". One Supercalender also required. Send complete details of machine including condition, age and selling price. Address Box 45-569 care Paper Trade Journal. S-27

WANTED — DISCARDED PAPER MILL FELTS. HIGHEST PRICES paid for all kinds of discarded paper mill felts. LARGE or SMALL QUANTITIES accepted. Prices quoted immediately on receipt of samples. ADDRESS: GLASER AND YOFFE, INC., 80 NORTH MAIN ST., NATICK, MASS. TF

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WANTED—Distributors located in Sweden, Norway, Finland, Mexico, Argentina, Brazil, Chile and Australia for product used by pulp and paper mills. Write in detail. Address Box 45-537 care Paper Trade Journal. S-27

MULTI-WALL BAG MACHINE WANTED. Describe manufacturer, size, range, condition, equipment, price. Cash purchase. Address Box 45-539 care Paper Trade Journal. TF

WANTED—W & P Shredders, Evaporators Generators and Boilers, Slitters, Cutters Hydraulic Presses, Sheridan Presses, Dryers Address Box 44-835 care Paper Trade Journal tf

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IN the market for one used but in first serviceable condition Paper and Cloth-gumming Machine, 63" wide. Send proposals to Mr. Ciro A. Martinez, Purchasing Agent, Apartado Postal No. 755, Monterrey, N. L., Mexico. D-20

WANTED—To lease or purchase Fourdrinier Mill. Address Box 45-599 care Paper Trade Journal. S-27

WANTED—Paper Mill Felts. Will take any quantity and weight. Address Box 45-612 care Paper Trade Journal. S-27

WANTED—3 Rag Cutters. 2 Slitters and Rewinders any size up to 100" considered. 2 Hamblet Cutters. Address Box 45-607 care Paper Trade Journal. O-11

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Moore & White Co.
D. J. Murray Mfg. Co.
The Sandy Hill Iron & Brass Works
Shartle Brothers Machine Co.
Smith & Winchester Mfg. Co.
Valley Iron Works Co.
Waldron Corp., John

GRINDERS
Farrel-Birmingham Co.
Lobdell Car Wheel Co.
Montague Machine Co.
Samuel C. Rogers and Company
The Sandy Hill Iron & Brass Works

GRINDING WHEELS
The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc.
Simonds Worden White Co.
United States Rubber Co.

HEATING, VENTILATING AND AIR CONDITIONING
The Appleton Machine Co.
Armstrong Machine Works
Fibre Making Processes, Ltd.
E. D. Jones & Sons Co.
General Electric Co.
Grinnell Company
Leeds & Northrup
D. J. Murray Mfg. Co.
Noble & Wood Machine Co.
Ross Engineering Corp., J. O.
Shartle Brothers Machine Co.
Stickle Steam Specialties Co.
Valley Iron Works Co.
Worthington Pump & Mchy Corp

HOISTS
Appleton Machine Co.
Dilts Machine Works
Rodney Hunt Machine Co.
Ingersoll-Rand Co.
E. D. Jones & Sons Co.

HOSE (Air, Water, Suction, etc.)
The Cincinnati Rubber Mfg. Co.
The Manhattan Rubber Manufacturing Division of Raybestos-Manhattan Inc.
United States Rubber Co.

INSTRUMENTS, TESTING AND MEASURING
W. H. & L. D. Betz
N. P. Bowsher
The Bristol Company
Builders-Providence, Inc.
The Foxboro Company
General Electric
W. & L. E. Gurley
Leeds & Northrup Company
National Technical Laboratories
B. F. Perkins & Son
Taber Instrument Corp.
Taylor Instrument Cos.
Wallace & Tiernan Co., Inc.

JORDAN FILLINGS
Appleton Machine Co.
Bahr Brothers Mfg. Co.
E. D. Jones & Sons Co.
Noble & Wood Machine Co.
Shartle Brothers Machine Co.
Smith & Winchester Mfg. Co.
Valley Iron Works Co.

KNIVES
Black-Clawson Company
Dilts Machine Works, Inc.
Hamblet Machine Co.
E. D. Jones & Sons Co.
Simonds Worden White Co.
Valley Iron Works Co.

LABORATORY EQUIPMENT
Appleton Machine Co.
W. H. & L. D. Betz
Dilts Machine Works
E. D. Jones & Sons Co.
Leeds & Northrup Company
National Technical Laboratories
Noble & Wood Machine Co.
Taber Instrument Co.
Taylor Instrument Companies
Valley Iron Works Co.

LAY BOYS
Hamblet Machine Co.
Moore & White Co.
Shartle Brothers

LUBRICANTS
Gulf Oil Corporation
Gulf Refining Co.
Sinclair Refining Co.
Socony-Vacuum Oil Co., Inc.
Sun Oil Company
The Texas Company
Tide Water Associated Oil Co.

LUBRICATORS
Hills-McCanna Co.

MATERIAL HANDLING
Northwest Engrg. Co.

MICROMETERS & CALIPERS
Farrel-Birmingham Co.
Montague Machine Co.
Lobdell Car Wheel Co.
Walker-Goulard-Plehn Co.

MIXERS
H. K. Porter Company
Youngstown Welding & Engrg. Co.

MOISTENING EQUIPMENT
The Spray Engineering Co.

MOTORS AND GENERATORS
Allis-Chalmers Mfg. Co.
De Laval Steam Turbine Co.
General Electric Co.
Ingersoll-Rand Co.
Reliance Electric & Engrg. Co.
Westinghouse Electric Corporation

PACKING BOXES
Johnson Corporation
Shartle Brothers Machine Co.

PACKING
The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc.
United States Rubber Co.

PAPER MACHINES
Black-Clawson Company
Downingtown Mfg. Co.
Thomas W. Hall Co.
Moore & White Co.
Pusey & Jones
J. J. Ross Company
The Sandy Hill Iron & Brass Works
Shartle Brothers Machine Co.
Smith & Winchester

PAPER MACHINE SLICES
Black-Clawson Company
E. D. Jones & Sons Co.
Montague Machine Co.
The Sandy Hill Iron & Brass Works
Valley Iron Works Co.

PAPERMILL BUILDERS
Merritt Chapman & Scott Corp.

PAPER TUBE MACHINERY
Dietz Machine Works
Thomas W. Hall Co.
Hudson Sharp Machine Company
Langston Co., Samuel M.

PASTING MACHINES
Black-Clawson Company
Davis, Frank H., Co.
Murray, D. J., Mfg. Co.
Moore & White Co.
Potdevin Machine Co.
Shartle Brothers Machine Co.
Waldron Corp., John

PERFORATED METAL
Allis-Chalmers Mfg. Co.
Harrington & King Perforating Co.
Hendrick Mfg. Co.

PIPE
Black-Clawson Company
Crane Company
Grinnell Company
Shartle Brothers Machine Co.
Stowe-Woodward Inc.
Taylor Forge & Pipe Works
Walworth Company
Youngstown Welding & Engrg. Co.

PLATERS
Perkins & Son, Inc., B. F.

PLATES
Black-Clawson Company
Hendrick Mfg. Co.
J. O. Ross Engrg. Corp.
Shartle Brothers Machine Co.
Timken Roller Bearing Co.

PLUGS
Black-Clawson Company
E. D. Jones & Sons Co.
The Noble & Wood Machine Co.
Shartle Brothers Machine Co.

PRESSES
Black-Clawson Company
Farrel-Birmingham Co.
Dietz Machine Wks.
Thomas W. Hall Co.
Hudson-Sharp Machine Co.
Paper Converting Machine Co., Inc.
Potdevin Machine Co.
Rotogravure Engineering Co.
Shartle Brothers
Valley Iron Works Co.
Waldron Corp., John
Weber, Homer G.

PUG MILLS
Traylor Engineering & Mfg. Co.

PULPS
Andersen Co., J.
Bulkley, Dunton Pulp Co., Inc.
Goetzeman & Co., Inc.
Elof Hanseon, Inc.
Perkins-Goodwin Co.
Price & Pierce, Ltd.
Pulp and Paper Trading Co.

PUMPS
Allis-Chalmers Mfg. Co.
Black-Clawson Company
Dorr Company
Downingtown Mfg. Co.
De Laval Steam Turbine Co.
Frederick Iron and Steel Co.
Hills-McCanna Co.
Ingersoll-Rand Co.
Johnson Corp.
Moore & White Co.
Nash Engineering Co.
Noble & Wood Machine Co.
Paper Converting Mch. Co.
Quimby Pump Co. Div. of H. K. Porter Company, Inc.
J. J. Ross Company
The Sandy Hill Iron & Brass Works
Shartle Brothers Machine Co.
Smith & Winchester Mfg. Co.
Warren Steam Pump Company
Worthington Pump & Machinery Corp.

RECOVERY SYSTEMS
Bulkley, Dunton Pulp Co., Inc.
Rodney Hunt Machine Co.
Moore & White Co.
D. J. Murray Mfg. Co.
Pusey & Jones
Ross Engineering Corp. J. O.
Valley Iron Works Co.

RECTANGULAR BINS
Traylor Engineering & Mfg. Co.

REELS
Black-Clawson Company
Downingtown Mfg. Co.
De Laval Steam Turbine Co.
Hudson Sharp Machine Company
The Kohler System Company
Montague Machine Co.
Moore & White Co.
Paper Converting Mch. Co.
Rodney Hunt Machine Co.
Rotogravure Engrg. Co.
The Sandy Hill Iron & Brass Works
Shartle Brothers Machine Co.
The Smith & Winchester Mfg. Co.

REFINERS
Appleton Machine Co.
Bahr Brothers Mfg. Co.
Bauer Brothers Co.
Dilts Machine Works
The Hermann Manufacturing Co.
E. D. Jones & Sons Co.
Murray, D. J. Mfg. Co.
Noble & Wood Machine Co.
Sandy Hill Iron & Brass Works
Shartle Brothers Machine Co.
Sprout, Waldron & Co.
Sutherland Refiner Corp.
Valley Iron Works

REGULATORS
Allis-Chalmers Mfg. Co.
Armstrong Machine Works
Bird Machine Company
The Bristol Company
The Brown Instrument Co.
The Foxboro Company
Jones, E. D., & Sons Co.
General Electric Co.
Johnson Corp.
Leeds & Northrup Company
National Technical Laboratories
Noble & Wood Machine Co.
Shartle Brothers
Stickle Steam Specialties Co.
Taylor Instrument Companies
Wallace & Tiernan
Westinghouse Electric Corporation

RESINS
American Cyanamid & Chemical Corp.
American Resinous Chemicals Corp.
The Resinous Products & Chemical Co.

ROLLS
Appleton Machine Co.
Black-Clawson Company
Downingtown Mfg. Co.
Farrel-Birmingham Co.
Improved Paper Machy. Corp.
Lobdell Co.
The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc.
Montague Machine Co.
D. J. Murray Mfg. Co.
Noble & Wood Machine Co.
Perkins, B. F., & Sons Co.
Pusey & Jones Corp.
Roehlen Engraving Co.
J. J. Ross Company
Rodney Hunt Machine Co.
The Sandy Hill Iron & Brass Works
Shartle Brothers Machine Co.
Shenango-Penn Mold Co.
Sinclair Co.
Smith & Winchester Mfg. Co.
Stearns Magnetic Mfg. Co.
Stowe-Woodward Inc.
United States Rubber Co.
Valley Iron Works Co.
Waldron Corp., John

ROLL COVERS
The Cincinnati Rubber Mfg. Co.
Stowe-Woodward Inc.
Youngstown Welding & Engrg. Co.

ROLL STANDS
Cameron Machine Co.
Johnstone Eng. & Machine Co.
The Kohler System Company
Moore & White Co.
Potdevin Machine Co.
Rotogravure Engrg. Co.
Shartle Brothers Machine Co.

ROTARY KILNS
Traylor Engineering & Mfg. Co.

SATURATING MACHINES
Black-Clawson Company
Moore & White Co.
Noble & Wood Machine Co.
Potdevin Machine Co.
Rotogravure Engrg. Co.
Shartle Brothers Machine Co.
Waldron Corp., John
Weber, Herman C.

SCALES
Builders-Providence, Inc.
Merrick Scale Mfg. Co.

SCREEN PLATES
Fitchburg Screen Plate Co.
Magnus Metal Corp.
Morey Paper Mill Supply Co.
Union Machine Co.
Union Screen Plate Co.

SCREENS
Allis-Chalmers Mfg. Co.
Appleton Wire Works
Appleton Machine Co.
Bird Machine Company
Carthage Machine Co.
Dilts Machine Works, Inc.
Downingtown Mfg. Co.
Harrington & King Perforating Co.
Hendrick Manufacturing Co.
E. D. Jones & Sons Co.
Montague Machine Co.
Moore & White Co.
D. J. Murray Mfg. Co.
J. J. Ross Company
The Sandy Hill Iron & Brass Works
Shartle Brothers Machine Co.
Traylor Engineering & Mfg. Co.
Valley Iron Works Co.

SCRUBBERS
Traylor Engineering & Mfg. Co.

SHEET MACHINES
Thomas W. Hall Co.
The Harmann Manufacturing Co.
Noble & Wood Machine Co.
Rotogravure Engrg. Co.
Valley Iron Works Co.

SHOWER PIPES
Bird Machine Company
A. E. Broughton & Co.
Downingtown Mfg. Co.
Improved Paper Machy. Corp.
Moore & White Co.
Shartle Bros. Mach. Co.
Smith & Winchester Mfg. Co.

SHREDDERS
Bauer Brothers Co.
Carthage Machine Co.

SIZING
American Cyanamid & Chemical Co.
American Resinous Chemicals Corp.
Black-Clawson Company
The Dow Chemical Co.
du Pont, E. I., de Nemours & Co.
National Oil Products Co.
Paper Makers Chemical Department, Hercules Powder Co.
Pioneer Salt Company
Socony-Vacuum Co.
Philadelphia Quartz Co.

SLITTERS
Black-Clawson Company
Cameron Machine Co.
Carthage Machine Co.
Dietz Machine Works
Downingtown Mfg. Co.
Thomas W. Hall Co., Inc.
Hamblet Machine Co.
Hudson Sharp Machine Company
Johnstone Eng. & Machine Co.
Langston Co., Samuel M.
Moore & White Co.
D. J. Murray Mfg. Co.
Potdevin Machine Co.
Rotogravure Engrg. Co.
J. J. Ross Company
The Sandy Hill Iron & Brass Works
Smith & Winchester Mfg. Co.
Valley Iron Works Co.
Waldron Corp., John

SPRAY NOZZLES
The Spray Engineering Co.

STAINLESS STEEL
Allegheny Ludlum Steel Co.
Eastern Stainless Steel Corp.
Industrial Steels, Inc.

STARCH
American Cyanamid & Chemical Corp.
Clinton Co.
National Starch Products, Inc.
Stein, Hall & Co., Inc.

WHERE TO BUY

STEAM SPECIALTIES
Johnson Corp.
Shartle Bros. Mch. Co.
Stickle Steam Specialties Co.

STRAPPING & STRAPPING MACHINES
Acme Steel Company
The Stanley Works

STUFF CHESTS
Downingtown Mfg. Co.
E. D. Jones & Sons Co.
Moore & White Co.
D. J. Murray Mfg. Co.
Noble & Wood Machine Co.
The Sandy Hill Iron & Brass Works
Shartle Brothers Machine Co.
Valley Iron Works Co.

SUCTION BOXES
Black-Clawson Company
A. E. Broughton & Co.
Downingtown Mfg. Co.
E. D. Jones & Sons Co.
Moore & White Co.
The Sandy Hill Iron & Brass Works
Shartle Brothers Machine Co.
Westinghouse Electric Corp.

SULPHUR
American Cyanamid & Chemical Corp.
Stauffer Chemical Company
Texas Gulf Sulphur Co.
Witco Chemical Company

SULPHUR BURNERS
Valley Iron Works Co.

TALC
American Cyanamid & Chemical Corp.
W. H. Loomis Talc Corp.
International Talc Company

TANKS
Frederick Mfg. Co.
E. D. Jones & Sons Co.
Kalamazoo Tank & Silo Co.
The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc.
The Noble & Wood Machine Co.
H. K. Porter Company Inc.
Rodney Hunt
J. O. Ross Engrg. Corp.
Shartle Brothers Machine Co.
Stowe-Woodward Inc.

Traylor Engineering & Mfg. Co.
United States Rubber Co.
Waldron Corp., John
Youngstown Welding & Engrg. Co.

THICKENERS, DECKERS & SAVEALLS
Bird Machine Company
Bulkley, Dunton Pulp Co. Inc.
Carthage Machine Co.
Dilts Machine Works
Dorr Co.
Downingtown Mfg. Co.
Montague Machine Co.
Moore & White Co.
D. J. Murray Mfg. Co.
J. J. Ross Company
The Sandy Hill Iron & Brass Works
Shartle Brothers Machine Co.
Valley Iron Works Co.

TITANIUM
E. I. Du Pont de Nemours & Co.
Titanium Pigment Co.
R. T. Vanderbilt Co.
Witco Chemical Company

TOOLS
Acme Steel Company
Ingersoll-Rand Co.
The Stanley Works
Walworth Company

TRUCKS
Automatic Transportation Co.
Elwell Parker Electric Co.
Wright-Hibbard Ind. Elec. Truck Co

TRAPS
Armstrong Machine Works
Crane Co.
Grinnell Company
Johnson Corporation
Shartle Bros. Mch. Co.

TUBS
Rodney Hunt Machine Co.
Noble & Wood Machine Co.
Shartle Brothers
Valley Iron Works Co.

TURBINES
Allis-Chalmers Mfg. Co.
De Laval Steam Turbine Co.
General Electric Company
Hunt, Rodney, Mach. Co.
Westinghouse Electric Corp.
Worthington Pump & Machinery Corp.

USED EQUIPMENT
Frank H. Davis Company
Gibbs-Brower Co.
Thomas W. Hall Co.
Noble & Wood Machine Co.
Rotogravure Engrg. Co.
J. J. Ross Company
Shartle Brothers Machine Co.

VALVES
The Bristol Company
Crane Company
Dilts Machine Works
Fibre Making Processes, Inc.
The Foxboro Company
Hills-McCanna Co.
E. D. Jones & Sons Co.
Kennedy Valve Mfg. Co.
Magnus Metal Corp.
D. J. Murray Mfg. Co.
Noble & Wood Machine Co.
The Permutit Company
William Powell Co.
The Sandy Hill Iron & Brass Works
Shartle Brothers Machine Co.
Stickle Steam Specialties Co.
Taylor Instrument Companies
Valley Iron Works Co.
Walworth Company

VATS & VAT PARTS
Union Machine Co.
Union Screen Plate Co.

WASHERS
Bird Machine Company
Downingtown Mfg. Co.
E. D. Jones & Sons Co.
Moore & White Co.
Noble & Wood Machine Co.
The Sandy Hill Iron & Brass Works
Rodney Hunt Machine Co.
Shartle Brothers Machine Co.
Valley Iron Works Co.

WATER CONDITIONING
The Permutit Company

WAXING MACHINERY
Black-Clawson Co.
Potdevin Machine Co.
Rotogravure Engrg. Co.
Shartle Brothers Machine Co.
Waldron Corp., John
Weber, Herman G.

WELDING EQUIPMENT
Allis-Chalmers Mfg. Co.
General Electric Company
Walworth Company
Westinghouse Electric Corp.

WET MACHINES
Black-Clawson Co.
Carthage Machine Co.
Downingtown Mfg. Co.
Moore & White Co.
Montague Machine Co.
Noble & Wood Machine Co.
Pusey & Jones Corp.
J. J. Ross Company
The Sandy Hill Iron & Brass Works
Shartle Brothers Machine Co.
Smith & Winchester Mfg. Co.
Valley Iron Works Co.

WINDERS AND REWINDERS
Black-Clawson Company
Cameron Machine Co.
Dietz Machine Works
Downingtown Mfg. Co.
Thomas W. Hall Co.
Hudson-Sharp Mach. Co.
Langston Co., Samuel M.
Johnstone Eng. & Machine Co.
The Kohler System Company
Montague Machine Co.
Moore & White Co.
Paper Converting Mch. Co.
Potdevin Machine Co.
Pusey & Jones Corp.
Rotogravure Engrg. Co.
J. J. Ross Company
The Sandy Hill Iron & Brass Works
Smith & Winchester Mfg. Co.
Waldron Corp., John

WIRES
Appleton Wire Works
Black-Clawson Company
Bulkley, Dunton Pulp Co. Inc.
Cheney Bigelow Wire Works
Hayden Wire Works
International Wire Works
Lindsay Wire Weaving Co.
Shartle Brothers Machine Co.

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